National Forum of
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Advisory Councils

Survey of Canadian Federal and Provincial Science and Technology Advisory Councils

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INTRODUCTION

This document has been prepared to provide an overview of the federal and provincial science and technology advisory councils in Canada. It summarizes the responses to a survey which is included as Appendix A. The survey was completed by council chairmen or staff and submitted to the National Forum of Science and Technology Advisory Councils for inclusion in this factbook. Information on the role and function of the councils and their administrative arrangements as well as lists of council members and publications available from the councils are included.

The mandates of the councils do not vary substantially from one province to another. The councils are generally charged with providing advice to government on matters relating to science and technology. There is more variability in the ways in which the councils act to fulfill their mandates. Some councils meet only a few times a year. Other councils have adopted a more active approach and hold meetings as frequently as once a month. These councils often strike ad hoc committees to examine special issues. In some cases the councils have produced substantial reports to document their findings and recommendations.

The provincial councils range in size from 11 to 36 members. Few councils have formal guidelines concerning the composition of the council and the selection of members. As Table 1 illustrates, industry representatives comprise approximately 50% of each council. Most provincial councils do not appoint members from out of province. Only Newfoundland and New Brunwsick have included non-residents on their councils.

An examination of membership lists demonstrates that there is little cross-membership between councils. Only eight members of the National Advisory Board on Science and Technology also sit on provincial councils (4 in Ontario, 2 in British Columbia and one each in Nova Scotia and Saskatchewan). One individual is a member of two provincial councils. Three members of Science Council are also members of provincial councils. Within provinces, there is little interaction reported between the advisory councils and the provincial research organizations. Only four provinces have appointed a representative of their PRO to the advisory council. In no case is the appointment of such a representative mandated by the terms of reference of the council.

Ministers of the appropriate department are members of two of the provincial councils and of the National Advisory Board on Science and Technology. In many cases where the Minister is not a member of the council, their deputies or staff are observers at council meetings. Two councils have appointed deputy ministers as members in their own right. In addition to ministers and deputy ministers, three councils noted the participation of the provincial premier. The Premier chairs the Premier's Council in Ontario. The Premiers of Nova Scotia and British Columbia occasionally attend council meetings.

Council chairmen are drawn from all sectors, as shown in Table 2. Reporting relationships vary, but are generally to the Minister of the Department of Technology or Development. A variety of mechanisms are used by the councils

to convey their advice to government. In all cases these include formal methods such as written reports and briefings. Informal mechanisms for information exchange, such as dinners and attendance at council meetings, are also important. One of the most frequently mentioned of these opportunities is interactions with ministers, deputy ministers and their staff during council meetings.

Five councils receive administrative support from within a department or provincial research organization. The remainder have established separate secretariats. The number of staff range from zero, in the case of councils supported from within a department, to fourteen in Quebec. Annual budgets for council activities are $50,000 to $1.4 million.

The range of activities reported by the councils is broad. It includes consideration of issues which extend beyond provincial boundaries, such as Quebec's studies of science and mathematics education, to province-specific topics such as British Columbia's deliberations on the TRIUMF facility. Most of the councils are truly advisory and explicitly avoid a role in policy development. Only four of the provincial councils reported that they had participated in the development of a provincial science and technology policy.

Perhaps the most striking fact revealed by this survey is the relative youth of the councils. Only one has been in existence for more than ten years. The remainder have functioned for three years or less. Three councils (Alberta, Saskatchewan and Manitoba) have been formed in 1989. Changes in the structure and function of some of the councils should be expected as they evolve. In this regard, the National Forum of Science and Technology Advisory Councils is timely. It will permit council members to share experiences that will shape the direction and the future of these important advisory councils.

TABLE 1

SCIENCE AND TECHNOLOGY ADVISORY COUNCILS
DISTRIBUTION OF CURRENT MEMBERSHIP

	Industry	Labour	Education/ Health Care	Provincial Research Organ.	Provincial Dept.	Federal Dept. or Agency	Other
Alberta	6	0	5	3			1
B.C.	8	0	6		4		
Manitoba	5	3	2	0	3	1	1
New Brunswick	7	1	2	1			
Newfoundland	6	0	6	0	0	2	2
Nova Scotia	11	1	9	1	2	4	
Ontario	19	3	4		7		3
P.E.I.	4	0	3	1	2	2	
Quebec	6	6	7	0	0	0	1
Saskatchewan	9	0	3	1		1	
NABST	19	3	10	0	0	7	2

SCIENCE AND TECHNOLOGY ADVISORY COUNCILS
CHAIRMEN AND REPORTING RELATIONSHIPS

NAME	FOUNDED	CHAIRMAN	REPORTING RELATIONSHIP
Alberta Research Council	1989	legislative assembly	Minister, Technology Research and Telecommunications
British Columbia Premier's Advisory Council on Science and Technology	1987	industry	Premier
Manitoba Research Council	-	industry	Ministry of Industry, Trade and Tourism
New Brunswick Minister's Advisory Board on Science and Technology	1987	head of PRO	to Government of New Brunswick, through Minister of Commerce and Technology
Newfoundland and Labrador Science and Technology Advisory Council	1988	university	Cabinet Committee on Research and Development
Nova Scotia Council of Applied Science and Technology	1987	university	Minister of Industry, Trade and Technology
Ontario Premier's Council	1986	Premier	-
Prince Edward Island Advisory Council on Science and Technology	1988	industry	Minister of Industry
Conseil de la Science et de la Technologie du Quebec	1983	President (employee of the Council)	Minister of Science and Higher Education
Saskatchewan Advisory Council on Science, Technology and Innovation	1989	Minister of Science and Technology	-
National Advisory Board on Science and Technology	1987	Prime Minister	-

ALBERTA RESEARCH COUNCIL

In late 1988 the Minister of Alberta Technology, Research and Telecommunications asked the Board of the Alberta Research Council (ARC) to assume additional responsibilities as a provincial science and technology advisory council. The ARC Board agreed to undertake these additional responsibilities on a trial basis for 1989. Terms of reference for the Board's new function are still being developed. They are expected to include:

a) undertaking studies, and providing advice as may be directed by the Minister of Technology, Research and Telecommunications, and

b) advising the government on research, science and development and technology matters as they relate to the industrial, economic and social development of Alberta.

The Board consists of 16 members which are appointed by Order in Council. The membership of the Board is specified by the Alberta Research Act as follows:

a) 1 member must be a member of the Executive Council;
b) 1 or more members may be a member of the Legislative Assembly but not described in clause (a);
c) 1 or more members may be selected from persons nominated jointly by the Governors of the University of Alberta, The University of Calgary and the University of Lethbridge, but must not be persons described in clause (a) or (b);
(d) no fewer than 8 members must be persons who are not employees of the Government and are not described in clause (a), (b) or (c).

The role of ministers and deputy ministers in relationship to the Board's advisory function has not yet been defined.

The Board will report to the Minister of Technology, Research and Telecommunications. Although no formal reporting has been undertaken to date, verbal and written reports and briefings are anticipated. In addition, there will be informal communications between the Minister's office, the Department and the chairman of the advisory council.

The Board will meet quarterly. The agendas for these meetings will be set through the Department of Technology, Research and Telecommunications in consultation with the chairman of the advisory council. Secretariat responsibilities will be carried out by a senior technical staff member of Technology, Research and Telecommunications with support from the Alberta Research Council Corporate Secretariat. The Council does not have a budget, but its expenses and those of its committees will be paid by the Department of Technology, Research and Telecommunications.

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BRITISH COLUMBIA
PREMIER'S ADVISORY COUNCIL ON SCIENCE AND TECHNOLOGY

The Premier's Advisory Council on Science and Technology was initiated by an Order-in-Council in June 1987. The mandate of the council is to advise the premier on matters related to science and technology. The council makes recommendations to the Premier in the form of written reports, letters and verbal briefings by the Chairman.

The Council has fourteen members, which are selected by the Premier. Members are recommended by the science, business and academic communities to the Minister of Advanced Education and Job Training (who is also the minister responsible for Science and Technology). The Minister is an ex officio member of the council. The council's secretariat includes a half-time administrator and secretary who are responsible for the day-to-day functions of the Council. In addition, a private sector director works with the secretariat on special events, studies and presentations. The council's budget for 1988/89 was approximately $205,000. Over $100,000 of this amount paid for consulting services purchased by the council.

Council receives briefings periodically from the Science Council of British Columbia. The Chairman of the Science Council is a currently a member of PACST. Council meets annually with the Premier's Economic Advisory Council to discuss issues of joint interest. The council has informal connections with other provincial and federal advisory councils. Two members of PACST sit on the National Advisory Board on Science and Technology.

The Council meets monthly. It also holds workshops or task force meetings as necessary to deal with specific issues or tasks at hand. Agenda items are recommended to the Chairman by council members, staff resource people, the Minister and the Premier. The council has no standing committees. The following task force committees are currently or have been active in the past eighteen months.

- TRIUMF/KAON
- Public Awareness
- Inventory of Resources
- Strategic Targets
- Canada Space Plan
- Science and Technology Policy
- Initiatives

Advice is informally communicated to the Premier during his attendance at council meetings - he attends on average one in four regular meetings - and at luncheon and dinner meetings hosted by the council or the science and technology community. Ministry personnel regularly attend council meetings as resource persons and relate council positions to their Ministers.

During the council's one and one half years of operation it has considered and provided advice on a broad range of science and technology matters. council endorsed the KAON project which would result in a high energy subatomic particle accelerator built at TRIUMF in the University of British Columbia lands. The project is seen as part of a broader science and technology action plan to make B.C. competitive in science and technology nationally and internationally. Currently a federal-provincial jointly funded eleven million dollar project definition study is being conducted.

Recognizing the need to cultivate interest in science among school age children and to promote the benefits of science and technology to the community at large, council recommended a public awareness program be undertaken by government. Recently, a "Scientist in the Schools" program was initiated whereby practising scientists are encouraged and assisted to make presentations to school audiences. The Ministry of Advanced Education is actively pursuing the public awareness recommendation on other fronts as well.

The council has actively supported the establishment of the Wireless Communication Research Centre in British Columbia, citing it as complementary to the established communications and microelectronics expertise in B.C. The B.C. government has committed to the project pending federal agreement and industry participation.

PACST has developed a paper on the history of research and development spending in B.C. and made recommendations for a five year spending program and for setting up a fund for research to increase investment of other sectors in B.C. This past October an ongoing Science and Technology Development Fund was announced. In its initial year, 10 million dollars was placed in the fund which is intended to emphasize collaboration between industry and the province's research community and as well, target certain industry sectors and emerging technologies.

The importance of technological development to sustained economic growth is well established. Appropriately, annual joint meetings between the Premier's Economic Advisory Council and PACST have been initiated. At the first meeting in 1988, the Councils discussed the proposed Science and Technology Policy, and R & D investment strategy, procurement policy, key industrial areas of economic development of B.C. and an understanding of the role of technology in the future of B.C.

A task force was struck in November 1987 to investigate the impact of the Space Plan in B.C. A comprehensive study was completed in July 1988 which included: an inventory of "skill sets" in B.C. which could participate in or benefit from participation in the Canadian Space Program; and recommendations to government on actions which will maximize participation. Based on the recommendations a one day forum, "Opportunities in Space", was held bringing together business people interested in participating in the space program. Follow-up workshops are planned focusing on opportunities within specific areas of the space program.

The prime achievement of council has been the formulation of a science and technology policy for British Columbia - "Strategies for Innovation". The policy was a Council initiative. The policy has not been accepted by the B.C. Cabinet. Currently, the council is developing initiatives and mechanisms which it sees as necessary to implement the policy.

Recent activities have included an assessment of the impact of free trade on B.C. from an S & T perspective; review of a discussion paper on "Hydrogen Opportunities for B.C.", a review of the SPARK report, initiated by the Science Council of B.C., which outlines a vision of the B.C. economy in the year 2000 and the sectoral strategic science and technology plans to achieve that vision; assistance in planning an International Technology Transfer Symposium to be held April 29 - May 2, 1990; a presentation to the Cabinet Committee on Regional Development outlining PACST activities and the significance of science and technology in addressing current Cabinet issues, and promotion of B.C. in relation to the pharmaceutical research and development initiative.

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MANITOBA RESEARCH COUNCIL

At the present time, the Board of the Manitoba Research Council acts in an advisory role to government on science and technology issues. The mandate of the Manitoba Research Council is as follows:

"The Manitoba Research Council is an industrial research and development organization established by the Province to strengthen the use of appropriate science and technology for the economic and social development of Manitoba through the provision of contract technology transfer, testing, product development, and other services for local national, and international private and public sector clients, both independently and through strategic alliances. MRC manages its resources prudently, acting as a responsible corporate citizen, dedicated to profitability, growth, the advancement of its employees, and the success of its clients."

The MRC is affiliated with the Department of Industry, Trade and Tourism. The Board uses written reports, verbal reports and briefings by the Board chairman to provide advice to the Minister. The Board has fifteen members who are appointed by the Minister of Industry, Trade and Tourism. There are no formal guidelines for the selection of members. At present, the Board has one member from outside of the province.

The Board meets six times a year. The agenda for these meetings is developed by the MRC president in consultation with the Executive Committee of the Board. The Board has two standing committees: the Executive Committee and the Planning and Review Committee. Ad hoc committees are formed as required. Recently, an ad hoc committee was established to provide advice to the province on several aspects of federal science and technology policies.

In its capacity as the provincial research organization, the MRC employs eighty full time staff. It has a budget of 5.5 million dollars.

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NEW BRUNSWICK
MINISTER'S ADVISORY BOARD ON SCIENCE AND TECHNOLOGY

The Minister's Advisory Board on Science and Technology was formed in 1987. It is an advisory body to the Government of New Brunswick, reporting through the Minister of Commerce and Technology. Its mandate is to provide counsel on science and technology policy and activities and the effect that these may have on social and economic development in the province. A measure of its success will be the record of improvements in the economy and the quality of life for New Brunswick citizens.

The membership of the advisory board consists mainly, but not exclusively of New Brunswick residents. There are currently three members on the board who do not live in New Brunswick. Members are selected primarily from industry and business, research institutions and organizations and organized labour. At present, the head of the New Brunswick Research and Productivity Council is a member of the Board. Ministers and deputy ministers are not members of the Board but do, however, attend meetings and dinners. The specific mandate of the Board is to monitor science and technology activity in New Brunswick and, as appropriate, outside the province and

1. To identify and debate science and technology issues arising therefrom and affecting New Brunswick, and, to provide advice to government, which could include either recommendations for action or requests for in-depth studies in specified areas prior to recommendations, or

2. Upon request, undertake task-oriented assignments such as:

   - reviews of the effectiveness of specific initiatives or relationships

   - consultations with respect to specific new ventures, or

3. From time to time and speaking as a group, enter public debate on matters appropriate to its specialized knowledge.

The Board meets two to three times per year. Agendas are drawn up in consultation between the Department of Commerce and Technology and the Chairman of the Board. Secretariat functions are provided by the Science and Technology Secretariat within the Department of Commerce and Technology. No specific budget has been allocated to the Board.

The Minister's Advisory Board on Science and Technology has held four meetings since its inception in 1987. A science and technology policy has been submitted to the minister.

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NEWFOUNDLAND AND LABRADOR SCIENCE AND TECHNOLOGY ADVISORY COUNCIL

The Newfoundland and Labrador Science and Technology Advisory Council (NLSTAC) was formed in May 1988. It was established to advise the provincial government on the formulation of science and technology policy and programs, and the development of strategies for utilization of science and technology for the economic and social development of the province. The terms of reference, as they were established at the inaugural meeting of the council, are as follows:

1) Advise on the formulation and implementation of science and technology policies.

2) Advise on needs for and mechanisms to gather, organize and disseminate information on scientific research, technology transfer and innovation.

3) Advise on mechanisms (educational, promotional or otherwise) to encourage the development and use of technology and the enhancement of skilled personnel in the province.

4) Advise on mechanisms and criteria for the evaluation and funding of research and development proposals and contribute to identifying strategic priorities and opportunities.

5) Advise on the impact of technology on business and labour and on the most effective means for dealing with technological change.

6) Facilitate discussions on science and technology policy with the federal government and/or the governments of other provinces and territories and/or interested groups or individuals.

7) Consider all matters brought to it by Ministers and report back to Ministers on such matters.

8) Present an annual report on the status of science and technology initiatives with the province.

The NLSTAC reports directly to the Cabinet Committee on Research and Development. Ministers and deputy ministers do not play an active role on the council. The council is composed of sixteen members drawn from a spectrum of disciplines related to science and technology and are appointed by the Premier. There are currently three members from out-of-province. Council activities are supported by a secretariat with a full-time staff of three, including an executive director, a director of research and a council administrator. The Council and its secretariat have a budget of $250,000 per year.

The council meets approximately ten times per year. Agendas for council meetings are determined by an Executive Committee. In addition to the Executive Committee, there are currently ad hoc committees for Oil and Gas, Medical Research, Public Awareness, Forestry and Education. Since its inception, the NLSTAC has made formal recommendations to government in two areas: medical research and offshore development initiatives. Following a review of policies relating to medial research funding in other provinces and based upon the report of its Medical Research Sub-Committee, the council recommended the establishment of a provincial health research foundation. It also reviewed three offshore development fund programs and made recommendations regarding their continuation.

Science education and public awareness are of key importance to the NLSTAC. A focus on education and public awareness is a critical first step in promoting science and technology in the Newfoundland economy. Council has advised on the preliminary design of a Science Awareness Program for young people and their science teachers entitled "Science and Technology: Window on the Workplace." Council is also represented on the advisory board for the National Science Fair which will be held in St. John's in May 1989. It has established an Award for Excellence in Innovation which will be judged and presented by a council member at each of the regional science fairs.

In 1989 the Council will host its first public forum on the theme of "Science Education and the Community". It has also discussed the possibility of collaborating with the Economic Council to host a public forum on Science, Technology and the Newfoundland Economy in late 1989. The council will continue to work toward its long term goal of developing a provincial science and technology policy. It is currently debating the merits of a sector by sector approach to establishing science and technology policies and priorities. As the council's work proceeds, it will begin to hold meetings outside of St. John's to provide a province-wide perspective on its deliberations.

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NOVA SCOTIA
COUNCIL OF APPLIED SCIENCE AND TECHNOLOGY

The Council of Applied Science and Technology (CAST) was formed in October 1987. The mandate of the Council is as follows:

1. to stimulate the application of Nova Scotia's science and technology assets in support of economic activity by working together with all parties concerned;

2. to advise and make recommendations to government on science and technology policies and programs which will contribute to economic development; and

3. to contribute to increasing the awareness of the importance of science and technology to economic development.

The council reports to the Minister of Industry, Trade and Technology through written reports, letters, meetings with representatives of the government and distribution of minutes. In addition, the Minister and Premier occasionally attend council meetings and scheduled dinners with members of council.

The council has twenty seven members. Although there are no guidelines concerning the composition of the council, it is expected that industry will be well represented on the council. The Deputy Minister of Industry, Trade and Technology is a member of the council. The Technology Transfer Office of the Department of Industry, Trade and Technology has functioned as the secretariat for the council. Half a person year has been dedicated to these activities. One full-time staff member will soon be recruited to take over the secretariat function from the TTO. The annual budget of the council is approximately $80,000.

CAST meets every six to eight weeks. Agendas are developed by an executive committee (consisting of the chairman, secretariat and several council members). Task forces are formed to address specific issues and are disbanded once their goals have been met.

Since its inception CAST task forces have provided analysis and advice on:

1) the reduction of sulphur emissions from coal-fired power stations

2) a comprehensive program to raise the awareness of science and technology among small to medium-sized businesses.

3) important factors for high technology development.

Recently, CAST has made recommendations to government on the development of a science and technology policy for Nova Scotia. It was instrumental in the initiation of a review of the economic strategy of the province, of which the science and technology strategy is a key component.

The council is presently engaged in discussions concerning the development of a provincial technology strategy, the design of a provincial centres of excellence program and advice on the use of community colleges as a means to accomplish technology transfer to rural areas.

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ONTARIO PREMIER'S COUNCIL

The Premier's Council was established by the Ontario government in the Throne Speech of April 22, 1986. The mandate of the council is to assist the government in developing long-term economic strategies and stimulating technological innovation in the province. The Council is directly affiliated with the Ministry of Industry, Trade and Technology, where its Secretariat is based. The Secretariat, headed by the Deputy Minister of MITT, reports to the Premier. The Council is also indirectly affiliated with five other ministries whose ministers are Council members: Treasury and Economics, Colleges and Universities, Education, Skills Development, and Labour.

The Council has thirty-six members, including the Premier and the six Cabinet Ministers representing the portfolios cited above. Members are selected on the basis of the constituency they represent (government, industry, labour, advanced research and education are the target areas from which representation is sought), their prominence within that constituency, and their ability to make a contribution to the work of the Council. There are no formal guidelines regarding representation of the various sectors. The Deputy Minister of Industry, Trade and Technology serves as Secretary to the Council, but is not a member.Deputies from ministries represented on the Council attend meetings in an advisory capacity to their ministers.

There is no formal relationship between the Premier's Council and other advisory groups in the province or in other jurisdictions. Several members of the Council also serve on other advisory councils, including the Science Council of Canada, the National Advisory Board on Science and Technology and the Economic Council of Canada. One council member is currently a member of another provincial advisory board.

The Council provides written advice to the government in the form of reports, two of which have been issued publicly. Ad hoc subcommittees of the Council occasionally provide oral or written reports to the Council on the progress of whatever program or special interest item they have been charged to handle. During the Council's regular meetings, members give and receive "reports" on ongoing activities or upcoming events. The Premier opens each meeting with a summation of Council milestones (e.g., Volume 1 is going into its third printing). The Premier or the Secretary to the Council on occasion provides a progress report on implementation of the Council's recommendations. Individual Council members sometimes offer presentations on issues or developments of note. On a regular basis, the Council receives reports, in the form of slide presentations, from its consultants on the results of research in progress. As required, reports on government programs initiated by the Council and operating under the Technology Fund are submitted and/or presented.

Apart from the Council meetings themselves, other informal mechanisms for reporting include subcommittee meetings, interministerial meetings, briefings of the Premier and Council Ministers provided by the Secretariat, and study team meetings (outside consultants meetings with Secretariat and ministry representatives to review findings to date).

The full Council meets approximately every six weeks, except during the summer months. The agenda is determined by the Premier on the advice of the Premier's Council Secretariat. The Secretariat coordinates requests from Council members and ministries to have items placed on future agendas. Long-term or ongoing agenda items, such as the next phase of the Council's research program, may be determined by a subcommittee of the Council in cooperation with the Secretariat, the Ministry of Industry, Trade and Technology and the Council deputies.

The Council has a number of standing and ad hoc subcommittees. The standing committees are the Scientific Advisory Panel for the Industry Research Program and the Centre of Excellence Subcommittee. Ad hoc subcommittees that have completed their work and no longer meet include the Subcommittee on the Human Resource Agenda and the Entrepreneurship Subcommittee (which was responsible for the creation of the Centres of Entrepreneurship and the Entrepreneur 88 Symposium). Several new subcommittees have been formed to address current issues relating to the human resource agenda: the Subcommittee on Education, the Subcommittee on Training, and the Subcommittee on Labour Adjustment. Another new subcommittee that will begin meeting shortly to assess proposals and recommend projects for approval is the Selection Panel for the Technology Adjustment Research (TARP).

The Premier's Council Secretariat was established to provide administrative, research and public relations support to the Council. The Secretariat has four full-time staff and employs a co-op student for part of the year. The Secretariat draws on occasion from staff of the Ministry of Industry, Trade and Technology to assist on special projects. The Deputy Secretary is responsible for the overall management of the Secretariat and the Council's work program. Reporting to the Deputy Secretary are two Senior Policy Advisors (one specializing in communications and policy, the other in research and analysis) and one support staff who provides administrative and secretarial assistance. The budget for the Premier;s Council Secretariat and other services to the Council is approximately $1.4 million annually.

The Council's major study of the current state and future opportunities for the Ontario economy is Competing in the New Global Economy. This work consists of three volumes, two of which have been released and a third that will be released in late April/early May, 1989. The eighteen months of research and analysis that produced Competing in the New Global Economy is the Council's contribution to the science and technology policy, as well as the overall economic policy, of the Ontario government. Several of the Council's fourteen recommendations have been transformed into programs designed to advance the science and technology agenda in the province. In addition, the organization of the Ministry of Industry, Trade and Technology may be changed to reflect the thinking behind the Council's report.

Even before the report was issued, however, the Premier's Council was helping to shape science and technology policy in the province. Programs like the Centres of Excellence, the Industry Research Program and the Technology Adjustment Research Program, all of which preceded the Council's report, where initiated by the Council to strengthen the province's science and technology infrastructure. Descriptions of some of the Councils' programs are found below.

Centres of Excellence

In June 1987, the Premier's Council designated seven Centres of Excellence at Ontario universities. The centres, backed by a government commitment of $204 million over five years, undertake long-term scientific and technological research and promote the transfer of technology from the academic world to industry. The Centres are co-operative ventures between universities and industries working in fields considered critical to Ontario's economic strength. The Ministry of Industry, Trade and Technology has primary responsibility for the program in collaboration with the Ministry of Colleges and Universities. A subcommittee of the Premier's Council meets on a quarterly basis to monitor the development and effectiveness of the Centres of Excellence.

Industry Research Program

The goal of the Industry Research Program is to stimulate industry-based research collaboration between private companies and other partners in areas that will improve the competitiveness of Ontario business. Projects must be based on sound scientific principles and display a degree of scientific risk, as well as economic and social benefits. They must include more than one partner, must contribute to training and development and must demonstrate a potential for the production of tradeable goods and services. The funding is in the form of grants of up to 50 percent of allowable costs. Applicants must be able to demonstrate their ability to finance their part of the program.

University Research Incentive Fund

The University Research Incentive Fund (URIF) is designed to encourage universities and the private sector to collaborate in joint research ventures. Administered by the Ministry of Colleges and Universities, the Fund matches private-sector investment in short-term university contract research. Funds flow to the universities and may be applied directly to the project or used to expand its scope. All Ontario universities and Ryerson Polytechnical Institute are eligible academic institutions. Private-sector partners can be Canadian corporations or foreign-owned subsidiaries operating in Ontario, industry-sponsored research organizations and Crown corporations receiving less than 50 per cent of their revenues from government.

As of August 1988, URIF had approved total funding of more than $21 million for 246 projects at 14 Ontario institutions. Amounts range from $6,000 for a mining-related study at the University of Toronto to $1.16 million for a large computer project at the University of Waterloo.

Centres of Entrepreneurship

Entrepreneurs and the employment they create play a vital role in the province's economic health and vitality. Recognizing this, the Premier's Council has designated six Centres of Entrepreneurship to be established in Ontario colleges and universities. With funding of $3.6 million over four years, the Centres' mandate includes developing programs and courses in innovation and enterprise. They will invite visiting entrepreneurs, venture capitalists, and researchers to discuss their experiences, practices and principles with students from all disciplines in the colleges and universities. The Centres will also stimulate research into entrepreneurial strategies and areas with potential for development by entrepreneurs. The program is administered by the Ministry of Colleges and Universities.

Technology Adjustment and Research Program (TARP)

The Technology Adjustment and Research Program, which will provide $5 million over 5 years for cooperative labour and industry studies of the impact of technological change on the workforce and the workplace. This program was developed by the Premier's Council in recognition of the need to study and anticipate the effects of technological change to facilitate the process of adjustment that industries and their workers must undergo. Major research projects will be undertaken to assess and prepare for the potential effects of new technology on workers, their immediate work environment, and the larger industry setting.

These studies will encourage cooperation among the labour and industry study partners and will be shared with the broader labour, industry, academic and government interests. The program will be of particular benefit to labour groups in addressing their long-standing problem of underfunding for research.

A subcommitee of the Premier's Council has been struck to design the program's eligibility criteria and the basis for project assessment and selection. The program should be fully operational within the year.

The Council's recently released report, Competing in the New Global Economy, offered a number of recommendations for further programs and directions that could advance Ontario's technological capabilities and competitive strength. The provincial budget of April 20, 1988 announced three new technology initiatives based on key recommendations contained in the Council's report:

Research and Development Super Allowance
Technology Personnel Program
Strategic Procurement Program.

The report also proposed that the Council address the "people" issues associated with its recommended economic strategy as part of its next agenda. As a result, the Council will examine important education, training and labour adjustment issues in the coming months.

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PRINCE EDWARD ISLAND ADVISORY COUNCIL ON SCIENCE AND TECHNOLOGY

The Prince Edward Island Advisory Council on Science and Technology was formed in August 1988. The Council's mandate is to work with institutions and industry to provide the leadership necessary to promote and enhance science, innovation, industrial research and development and technology transfer on Prince Edward Island while maximizing advantages and minimizing disadvantages. The objectives of the Council are as follows:

1) to increase public awareness and understanding of, and attitudes toward, science and technology that will enhance the ability of Islanders to adapt to new appropriate technologies and increase initiatives in the science fields;

2) to maximize the inflow of dollars into provincial research, innovation and technological advancements;

3) to stimulate the application of science and technology to enhance industrial competitiveness and job creation through research and development and exploiting of technology;

4) to create a co-ordinated infrastructure through identification of linkages between industry and institutions (government, college and university) influencing science-related activities, innovation and technological advancements.

The council has twelve members who are appointed by the Minister of Industry, to whom the council reports. The terms of reference for the council specify that five members should be drawn from the private sector (4 from industry, one from labour). In addition, the presidents of Holland College and the University of Prince Edward Island, the Dean of the Atlantic Veterinary College, a representative of the federal Department of Industry, Science and Technology and the Deputy Minister of the provincial Department of Industry are automatically members of the council.

The council meets approximately twelve times per year. Agendas for these meetings are determined by the chairman in consultation with members. Council activities are supported by the Manager of Science and Technology, Department of Industry and by a secretary. The council does not yet employ any full time staff. The Council does not have a specific budget; the budget for the Science and Technology Section within the Department of Industry is $152,000 for 1989-90.

The expected activities of the council were described in the rationale for the establishment of the council. They include:

1. increase public awareness of the economic importance of science and technology and the ability to manage technology;

2. identify, priorize and recommend policies and programs to stimulate science and technology advancement in Prince Edward Island;

3. encourage Island firms to develop ways of utilizing science and technology to increase competitiveness;

4. strengthen linkages between science and technology institutions and industry;

5. develop and maintain an inventory of Prince Edward Island's science and technology assets and the technological needs of industry;

6. monitor provincial and federal science and technology programs and spending;

7. to promote and identify opportunity for research and development within our institutions that will ensure a balance between basic and experimental/contractual research;

8. provide, via an annual reports, advice to the provincial government on matters of science development, innovation initiatives and technological transfer.

To date, the council has discussed a variety of issues including the provincial science and technology strategy and the promotion of science and technology awareness and education for students and the general public. In 1989, the council will examine the province's Science and Technology Strategy, which was first prepared in 1987, in order to ascertain what changes are required to update the strategy. A sub-committee on aquaculture will present its recommendations for the council's consideration. In addition, the council will be involved in the preparation of a communications plan designed to promote science and technology on Prince Edward Island. The plan consists of a video, a radio advertisement and a provincial science conference as well as a file folder/brochure to be utilized to disseminate information concerning science and technology.

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CONSEIL DE LA SCIENCE ET DE LA TECHNOLOGIE DU QUÉBEC

The Conseil de la science et de la technologie du Québec has existed for seventeen years. In the first period of its history, from 1972 to 1980, the Council, called Conseil de la politique scientifique du Québec, had a part-time president and nearly no secretariat. After a few years of intermittent activities, the CPSQ was revived in 1981 and given a full-time president and a small secretariat. Until 1983, the CPSQ existed by virtue of an Order in Council. In August 1983, a law established the Council on a more permanent basis. At the same time, its name was changed and became "Conseil de la science et de la technologie du Québec".

The council reports to the Minister of Science and Higher Education. Its mandate is to provide the Minister with advice on any matter relating generally to the advancement of science and technology. This advice is usually provided in the form of written public reports. The president occasionally communicates privately with the Minister and the minister may attend council meetings.

The council has fifteen members, including the president who is a full-time employee of the council. Members are selected from the research, college and university, business and labour communities, the field of scientific and technical information and the public and parapublic sectors. In addition to the regular members, there are three government-appointed observers from the Department of Science and Higher Education, the Department of Industry, Trade and Technology and the Conseil des universites. The council has a staff of 14 full-time employees and 7 part-time employees. These include five full time science advisers who are given assignments according to the council's agenda. There is also a documentation centre and a professional responsible for public relations and publications. The council's total budget for 1988/89 was $1.2 million. This provided for the salaries of full- and part-time staff as well as costs related to contracting out of studies.

The Council meets approximately five times per year. The agenda for council meetings is determined by a planning committee composed of four council members in addition to the president and secretary. The council strikes ad hoc committees for each subject which is being examined by the council. At the present time there are three ad hoc committees:

Priorities and Strategic Planning
Public Procurement and Technology Development
Research and Development Tax Credits

The council is required by law to publish, biennially, a report on the state and the needs of science and technology in Quebec. The first report called "Science et Technologie, Conjoncture 1985" was published in May 1985. The second, "Science et Technologie, Conjoncture 1988", was published last September. The third will be published in September 1990.

In 1982 the Council initiated a series of surveys of the science and technology activities in various regions of Quebec. Eight such surveys have been completed (see section C of the List of publications) and three more will be completed this year. Finally, the council has prepared a variety of formal statements on more specific areas of science and technology policy (see section B of the List of publications). Also, the council has published a series of briefs, monographs and proceedings (see section D of the List of Publications).

The Council is currently giving priority to studying the following six questions:

Fostering knowledge and adoption of new technology

The Council will report on the policy of fostering knowledge and adoption of new technologies in the manufacturing sector in Quebec. Several observers have noted that industrial structures can adapt to international competition much more quickly by taking advantage of previously developed technologies than by developing new ones: on an international level, given its size and ability, Quebec can achieve only modest results in this area. It is urgent that a policy on fostering knowledge of technology be developed to complement an R&D policy. How can the main sources of support for industry - specifically, scientific and technical information, availability of capital, and a trained work force - support this development strategy?

This document will concentrate on our educational system, addressing the question of work force training at different levels of education.

Priorities and strategic orientations

The idea of a Quebec sector strategy has been proposed. A choice must be made between the profitable sectors and the less profitable ones. Over the next few months, the Council will prepare a study paper on priorities and strategic orientations for Quebec. What can such choices be based upon? What other efforts have already been made in Quebec, in Canada, in other countries, and with what degree of success? At the present time, what can be proposed for identifying priority areas and strategic orientations for Quebec? These are all questions that this paper will attempt to address.

Government procurement and technological development

As a result of the technology summit held in Montreal in October 1988, a proposal was made to turn more toward government and Crown corporation purchasing and contracting-out policies to encourage the technological development of industries. Departments, Crown corporations and parapublic organizations wield considerable purchasing power. In the past, several constraints have limited the use of this spur to

technological development. The Council will examine the issue of government procurement and technological development in Quebec and plans to make recommendations to the government.

Fiscal measures to encourage R&D

With respect to fiscal measures, the Council held a seminar on March 31, 1989. The information brought forward at this seminar will enable companies to concentrate on what they see as the advantages and practical difficulties of such measures, and to make better use of them, will help the government attain the objectives it is pursuing, and will enable the Council to look critically at the effectiveness of this scientific and technical development support strategy.

Science and mathematics education

The Council plans to examine the subject of science and mathematics education. Other Canadian provinces and many American states have reviewed or are in the process of reviewing their positions in this area. The Council has sponsored a study of the North American experience to see where Quebec can derive the most benefit. Once this status report is completed, the Council will provide information on the contribution it will be able to make to this important debate.

Regional reports

This Council is continuing the vast operation of inventorying scientific and technological activities in the regions of Quebec. In addition to those already published, reports will be made available for Lanaudiére (06 D), the Laurentians (06 B) and Montérégie (06 C).

All the publications of the Council are in French. However, for some of the important publications, the Council provides executive summaries in English.

Publications as of October 1, 1988

A. REPORTS ON THE STATE OF SCIENCE AND TECHNOLOGY IN QUÉBEC

A1 **Science et technologie - Conjoncture 1985**
(The State of Science and Technology, 1985)
Vol. 1 Les enjeux (Issues) (63 p.)
Vol. 2 La situation (The Situation) (125 p., April 1986)

A2 **Science et technologie - Conjoncture 1988**
(The State of Science and Technology, 1988)
(218 p., September 1988)

A3 **Science et technologie - Conjoncture 1988**
(The State of Science and Technology, 1988)
Summary (64 p., September 1988)

B FORMAL STATEMENTS OF THE COUNCIL

B1 **Le programme de soutien à l'emploi scientifique**
(The programme of Support for Employment of Scientists)
(42 p., 6 annexes, June 1984)

B2 **Le développement industriel des biotechnologies au Québec**
(The Industrial Development of Biotechnologies in Quebec)
(68 p., May 1985)

B3 **L'emploi des diplômés en sciences sociales et humaines dans l'entreprise**
(Employment of Social Science and Humanities Graduates in Business)
(64 p., March 1986)

B4 **La participation des femmes en science et technologie au Québec**
(The Participation of Women in Science and Technology in Quebec)
(102 p., September 1986)

B5 **La politique des subventions de contrepartie et les universités du Québec**
(The Matching Funds Policy and Quebec Universities)
(68 p., November 1987)

B6 **La performance du Québec dans le cadre de la politique fédérale d'impartition**
(Quebec's Performance in the Federal Contracting-out Policy)
(83 p., April 1988)

C. ASSESSMENTS OF SCIENTIFIC AND TECHNOLOGICAL ACTIVITIES IN THE REGIONS OF QUÉBEC

C1 **Saguenay - Lac Saint-Jean - Chibougamau**
(93 p., 6 annexes, February 1983)

C2 **Mauricie - Bois-Francs - Drummond**
(194 p., 6 annexes, April 1984)

C3 **Estrie**
(140 p., [The 8 annexes are published as a separate volume], November 1984)

C4 **Abitibi - Témiscamingue**
(327 p., 7 annexes, April 1985)

C5 **Outaouais**
(147 p., 2 annexes, June 1986)

C6 **Est-du-Québec (Eastern Region of Quebec)**
(239 p., 5 annexes, February 1987)

C7 **Côte-Nord (North Shore)**
(139 p., June 1987)

C8 **Québec (Quebec region)**
(230 p., December 1987)

C9 **Lanaudière**
(to be published)

D. BRIEFS, REPORTS AND PROCEEDINGS

D1 **Mémoire au groupe de travail sur les politiques et programmes fédéraux en matière de développement technologique**
(Memoir to the Working Group on Federal Policies and Programmes for Technological Development)
(30 p., February 1984)

D2 **Les priorités de la politique scientifique et technologique du Québec**
(Priorities in Science and Technology Policy in Quebec)
Report on a conference organized by the Conseil on February 8, 1984 in Montreal. By Réjean Landry.
(21 p., July 1984)

D3 **La protection des programmes informatiques par le droit d'auteur**
(Protection of Computer Programmes By Copyright)
Paper presented to the Canadian Parliamentary Sub-Committee for the Review of Copyright Laws
(52 p., March 1985)

D4 **La diffusion de la culture scientifique et technique au Québec**
(Diffusion of Science and Technology Literacy in Quebec)
by Jean-Marc Gagnon and Lise Morin
(123 p., March 1986)

D5 **La collaboration université-entreprise et le financement de la recherche universitaire**
(University-Industry Collaboration and the Financing of University Research)
Paper presented to the Parliamentary Commission on Education during its general inquiry into the orientation and financing of the Quebec university system.
(30 p., September 1986)

D6 **Recherche et formation en biologie végétale au Québec**
(Research and Training in Plant Biology in Quebec)
by Pierre Morisset et Rose-Marie Pelletier
(130 p., October 1986)

D7 **L'organisation de la politique scientifique et technologique au Québec**
(The Organization of Science and Technology Policy in Quebec)
(31 p., November 1986)

D8 **Les conséquences de la décentralisation régionale des activités de R-D**
(The Consequences of Regional Decentralization of R&D)
by Robert Lacroix and Fernand Martin
(157 p., May 1987)

D9 **Sciences sociales et transformations technologiques**
(The Social Sciences and Technological Change)
(Proceedings of a conference jointly organized by the *Conseil de la science et de la technologie* and the *Regroupement québécois des Sciences sociales* (Quebec Social Sciences Association), held in Montreal on April 25, 1986.
(305 p., Juin 1987)

D10 **Les avantages fiscaux associés aux activités de recherche et de développement**
(Fiscal Benefits of R&D)
(53 p., March 1988)

D11 **La diffusion des nouvelles technologies dans trois secteurs industriels**
(The Diffusion of New Technologies in Three Industrial Sectors)
By Pierre-André Julien, Jean-Bernard Carrière and Louis Hébert.
(46 p., May 1988)

D12 **Les conditions du développement technologique de l'entreprise en région**
(Conditions for the regional technological development of business)
(Report of a colloquium held under the auspices of the *Conseil* on April 28 and 29, 1988)

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SASKATCHEWAN ADVISORY COUNCIL ON SCIENCE, TECHNOLOGY AND INNOVATION

The Saskatchewan Advisory Council on Science, Technology and Innovation was formed in January 1989. It was established to assess and advise on the development of provincial goals and policies for the application of science, technology and innovation in order to strengthen and diversify the Saskatchewan economy in the world market place. The specific objectives of the Council are:

1. To recommend priorities and strategies essential to the development of a science and technology policy aimed at diversifying and strengthening the provincial economy and the quality of life for Saskatchewan residents. This includes the broad range of research, economic development, commercialization, marketing industry assistance, relocation and education.

2. To identify target sectors and technologies within the context of a science and technology Policy.

3. To identify ways of encouraging partnerships among research institutions, industry, labour and government in order to foster an effective approach to the commercialization of research and development initiatives.

4. To advise on required programs and services which will encourage the creation of new technology-intensive industries and expansion of existing ones.

5. To recommend means for strengthening the science and technology components at all levels of the educational system so that scientific and technological literacy is improved and more people are attracted to careers in science and technology.

6. To identify programs and services required to ensure that Saskatchewan has an adaptable workforce that can support and benefit from ongoing technological change.

7. To recommend approaches for communicating the benefits of science and technology to the general public so that the public understands and supports science and technology policies and initiatives.

8. To identify current and anticipated domestic and international developments and trends in science, technology and innovation as these may affect the industrial sector, the scientific community and the general public.

Membership guidelines specify that the majority of members should be drawn from industry, with similar representation in total from university and research organizations. At present, the council has fourteen members. These include a member of the National Advisory Board on Science and Technology and

the president of the Saskatchewan Research Council. The SACSTI is chaired by the Minister of Science and Technology. In addition, the Deputy Minister sits on the council as an ex officio member. The council will provide advice to government through its chairman, and through written reports and interactions with other cabinet ministers.

The council is scheduled to meet quarterly. Agendas for council meetings will be defined by the council itself. The Department of Science and Technology will provide staff support to the council. The council's 1989/90 budget is $50,000 for special studies and reimbursement of members' travel and living expenses.

The council has no activities to report because it has only been in existence for a few months.

SASKATCHEWAN
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Executive Vice President
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Mr. Gerald Thom
President
Westbridge Computer Corp.

NATIONAL ADVISORY BOARD ON SCIENCE AND TECHNOLOGY

The National Advisory Board on Science and Technology (NABST) was established in early 1987 following its announcement in the 1986 Speech from the Throne. The purpose of the Board is to advise the Prime Minister on how science and technology can be more effectively exploited in Canada. Specifically, the Board can:

- advise on the appropriate use of government instruments for encouraging the development of science and technology, including statutes, budget measures and regulatory measures;

- propose means to sensitize Canadians to the profound changes resulting from the technological revolution, and to help them make the necessary adjustments;

- identify changes that may be required in our educational and training institutions;

- develop methods by which government can assist industry in responding to the challenges of international competition;

- advise on how best to coordinate the efforts of industry, labour, universities and government in pursuing national goals;

- recommend priorities for the support of scientific disciplines, strategic technologies and national programs; and,

- respond to specific questions or tasks assigned by the Prime Minister.

The Board reports to the Prime Minister through written reports presented by working committee chairpersons. Informal communication takes place through individual letters to the Prime Minister or concerned Ministers outside of meetings and individual verbal comments to the Prime Minister and attending Ministers during meetings.

The Board has thirty four members who are appointed by the Prime Minister. Members are drawn from industry, universities and labour. Representatives of industry represent over half the total membership. At present, seven members of NABST are also members of provincial advisory councils. The Board has eight ex officio members, including the Chairman of the Science Council of Canada, federal ministers and the presidents of the granting councils.

The Prime Minister is the chairman of the Board. The Ministers of Science and Industry, Science and Technology are the Deputy-Chairmen of NABST. The activities of the Board are reported by its Deputy-Chairmen to the Council of Ministers of Science and Technology. The Deputy Minister of Industry, Science and Technology Canada serves as the Secretary of NABST.

The Board meets as often as required, but lately it has met twice a year with the Chairman, twice a year with a Deputy-Chairman and as often as required with working committee chairpersons. To date, the Board has had fifteen plenary meetings. Agendas are determined in consultation with the Steering committee of NABST made up of the Deputy-Chairmen, the Secretary, the Vice-Chairmen and four other members. Working committees are created each time an issue is referred to the Board by the Prime Minister.

The Secretariat of the Board is located within Industry, Science and Technology Canada. It is a small team of four professionals which assists the Board in addressing the issues referred to it by the Prime Minister and which also advises the federal government on the best manner in which it should respond to the advice of the Board. The Secretariat has a permanent budget of seven person-years. Personnel are also hired under contract as required. The permanent staff of the Secretariat include:

Assistant Secretary (Head of Secretariat)
Senior Advisor (works with working committee)
Senior Advisor (works with working committee)
Senior Advisor (works with working committee)
Administrator (personnel, finance, administration)
Secretary (to Assistant-Secretary)
Secretary (to Senior-Advisors)

The Secretariat of the Board disposes of a budget of $1,000,000.00.

The Board's recommendations have helped shape federal government science and technology policies and programs in a range of areas. The following list summarizes recent NABST committee work:

InnovAction

This committee reviewed science and technology policy and InnovAction proposals under consideration at the time, and recommended support for specific funding proposals. These recommendations were largely enacted.

Government Research and Development

General goals were developed for federal science and technology, and recommendations were made on ways in which these goals could be attained: regular science audits, a methodology for resource reallocation, more basic research should be devolved to universities, more incentives for excellence.

University Research and Development

This committee dealt with a wide range of issues relating to post-secondary education, university research and university-industry relations. In response to recommendations falling within federal jurisdiction, a series of initiatives have been announced to increase support for university research, including the Canada Scholarships

Program, the establishment of the Networks of Centres of Excellence Program, and increased funding for the Granting Councils.

Industry Research and Development

This committee made a number of recommendations relating to two principal thrusts: maximizing the benefits of technological change, and minimizing the disruptions of that change. The influence of the committee has already been felt in the areas of tax reform and the development of highly qualified personnel.

Creation of the Department of Industry, Science and Technology

The planning of the Department has been influenced significantly by consultations with NABST. The principles put forward affected the organization of the department, focusing its principal activities on framework policies, services and programs linked to excellence in science, pre-competitive research, alliances, and international competitiveness.

Public Awareness of Science and Technology

The committee was asked to review and comment on the federal Public Awareness Campaign. Recommendations concerning objectives, target groups, the choices and use of media, the messages, and the participation of the provinces and territories have been considered in the planning of the campaign.

Participation of Women in Science and Technology

The committee reviewed the situation of women pursuing studies and careers in science and technology and made a number of recommendations which influenced the Public Awareness Program, and the Canada Scholarships Program.

The present work of NABST committees, initiated in 1988, has the following principal tasks:

Federal Science and Technology Expenditures

This committee has been tasked with advising government on how best to evaluate the quality of its research effort and to make its programs more effective. The committee is first developing an evaluation framework in consultation with departments and will then apply this framework to selected departments.

Big Science

NABST has been asked to design a decision framework which would help the federal government in assessing opportunities to invest federal funds in "Big Science" initiatives.

Private Sector Challenge

This committee is determining the best ways of encouraging a greater private sector committee to science and technology and innovation.

Government Procurement

Federal procurement policies and programs were studied and commented on by this committee. As part of the process of responding to the NABST recommendations, the government has initiated detailed discussions between NABST members and senior officials of the departments with major procurement responsibilities.

In its third year of operation, it is proposed to include the following items in the work program of NABST:

National Science and Technology Priorities

This committee would identify issues in science and technology that are of national importance and would recommend priorities and the strategies needed to deal with them. The participation of NABST in the National Forum of Science and Technology Advisory Councils would constitute an early element in this task.

Technology Transfer

NABST would investigate the contribution of federal research and development to industrial development through technology transfer; examine current policies and practices in government and factors in industry which affect technology transfer; and propose improved of new policies and mechanisms to accelerate this transfer.

The Financing of Industrial Research and Development

It is proposed that NABST investigate the cost and availability of capital required to support industrial research and development.

The issues that have been referred to NABST committees are categorized above as recent, present and future tasks. However, it must not be assumed that an issue has been resolved because the associated NABST committee has completed its immediate task. A number of items will receive close and continuous attention, including:

- the development of highly qualified personnel;
- public awareness of science and technology;
- university/industry/government partnerships; and
- technology transfer, diffusion and management.

The following publications are available from the Board:

- Government Committee Report
- University Committee Report
- Industry Committee Report
- Public Awareness Committee Report
- Economic Summit Proposal Committee Report
- Participation of Women in Science and Technology Committee Report
- Government Procurement Committee Report
- Department of Industry, Science and Technology Committee Report
- InnovAction Committee Report

NATIONAL ADVISORY BOARD ON SCIENCE AND TECHNOLOGY

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APPENDIX A

National Forum of Science and Technology Advisory Councils

Survey for Factbook

Please answer the following questions concerning your province's Science and Technology Advisory Council or its equivalent.

1. When was the council formed?

2. What are the council's terms of reference? Please attach relevant documentation.

3. With what provincial department(s) is the council affiliated?

4. To which Minister does the council report?

5. What formal mechanism(s) does the council use to report on its activities and to provide advice to government? (e.g. written reports, verbal reports, briefings by Chairmen, etc.)

6. What informal mechanisms have evolved for these purposes? (dinners, attendance by Premier, etc.)

7. What is the relationship between the council and other advisory groups (e.g. the provincial research foundation and/or science council)?

8. What informal or formal relationships does the council have with other provincial science and technology councils and/or with NABST or the Science Council (including cross membership)?

9. How many full members sit on the council?

10. How many ex officio members?

11. How are members selected?

12. Does the council have members from out of province?

13. Are there guidelines concerning the representation of government, industry and universities on the council?

14. What role do ministers and/or deputy ministers play on the council?

15. How often does the council meet?

16. How is the agenda for council meetings (issues to be considered by the council) determined?

17. Does the council have standing and special or ad hoc committees? What are they?

18. Has the council participated in the formulation of a formal science and technology policy for the province?

19. Did it play a role in discussions concerning the federal-provincial policy on science and technology?

20. What studies (commissioned or internal) have been undertaken by the council?

21. What publications are available from the council? (Please attach copies.)

22. Please describe the structure and function of the council's secretariat.

23. How many full-time and part-time staff does the council employ?

24. What are their titles and roles?

25. What is the council's budget?

26. Please provide a brief history of the council and its activities and achievements.

National Forum of Science & Technology Advisory Councils

Background Papers

Halifax, Nova Scotia
June 1989

Background Papers

Prepared for

The National Forum of Science and
Technology Advisory Councils

June 18-20, 1989
Halifax, Nova Scotia

The National Forum of Science and Technology Advisory Councils meeting in Halifax represents the first opportunity for advisory council members to focus their own activities, mandates and goals in the context of the work of similar Councils. The participants will discuss two major topics: the process by which advisory councils can function most effectively and the issues which might link the councils through cooperative action.

These papers provide some background for these discussions. The first paper summarizes, using statistics, Canada's relative standing and position in science and technology.

The means by which other jurisdictions develop and implement science and technology policy is the subject of the second paper, which was provided by the Department of Industry, Science and Technology. It considers the science and technology policy structures of the United States, the United Kingdom, the Federal Republic of Germany, France, Japan, Australia and Canada.

The third paper summarizes the issues which were identified by Canadaian science and technology advisory groups as important and having high priority on their agendas. It also contains a preliminary list of suggestions for cooperation between councils.

Science and Technology: Canada's Challenge in the Global Economy

A Background Paper and Statistics Prepared for

The National Forum of Science and Technology Advisory Councils

June 18-20, 1989
Halifax, Nova Scotia

"Until recently, the impact of technology on the economy was not seen as a legitimate focus of public policy. The federal government has invested heavily in technology development over the years, but primarily for specific public missions, such as national security, space exploration, and health ...the commercial implications of the technology have been considered only secondarily, if at all."

- M.I.T. Commission on Industrial Productivity
Made in America

"It has long been understood that technological change, through its impact on the economies of production and on the flow of information, is a principal factor determining the structure of an industry on a national scale. This has now become true on a global scale."

- *Technology and Global Industry*

"Two distinct kinds of manufacturing industry are emerging -- one is material-based, represented by the industries that provided economic growth in the first three-quarters of this century. The other is information and knowledge-based: pharmaceuticals, telecommunications, analytical instruments, and information processing such as computers. It is largely the information-based manufacturing industries that are growing."

- *Peter Drucker*, "The Changed World Economy"
in Foreign Affairs

"Technological innovation no longer fits the simplistic straight-line view to which America clings: of basic research leading to applied research, leading to technological development, leading to new products. Today's successful innovation is a complex blending of skills, but described as technological fusion."

- *The Economist*

"Technology is the parent of job creation."

- *President Ronald Reagan*

"Japan's economic development has been strongly supported by the adaptability of firms on a micro level based on entrepreneurship and technical innovation."

- *White Paper on Japanese Economy 1988*

"Many factors, including societal, educational, and financial ones introduce great uncertainty into determining who is winning the technology war. Because America, the nations of Europe and Japan all have different value systems, it is difficult to estimate one nation's progress or to compare the competitive positions of several nations."

- *The Technology War: A Case for Competitiveness*

"As the 40 year post-war epoch of growing markets and domestic-only competition fades, so too is vanishing the narrow one-company, one-industry chief executive. By the turn of the century, companies' choice of leaders will be governed by increasing international competition, the globalization of companies, the spread of technology, demographic shifts, and the speed of overall change."

- *Wall Street Journal*

"Technological innovation is not a priority with Canadian business executives. In fact, there is a lack of in-house technical and management skills. Only about three percent of Canadian manufacturing companies do any R&D. Furthermore, seventy percent of Ontario's manufacturing industries do not have even one engineer on staff."

- *Adjusting to Win*, the de Grandpre Report

"That more U.S. companies do not use more aggressive financial policies is curious. This can partially be explained by the risk aversion policies of U.S. banks, financial institutions, and corporate management. Also, aggressive financial policies do not usually fit with desire for higher short-term profitability."

- *Abegglen and Stalk, Kaisha*

INTRODUCTION

The Halifax meeting of the National Forum of Science and Technology Advisory Councils is both timely and opportune. Global interest in science and technology issues and strategies, from both the public and private sectors, is particularly acute. A number of common problems and challenges have created this heightened interest and awareness:

- Rising costs globally of military technology;
- Allocation of resources to medical science;
- Environmental impacts of scientific trends;
- Technological sophistication of the workplace;
- Globalization of technological forces, particularly in information, computers, office automation and telecommunications;
- Science policy as a key to industrial policy, economic growth, wealth creation, and job creation.

Canada is caught up in this vortex of world trends. This is evident in the leadership provided by Canadian companies (Northern Telecom in telecommunications, Connaught in vaccines, Spar in space-related equipment, Bombardier in transportation, Nova in petrochemicals, to name a few), and in the importance of technologies in all aspects of Canadian life -- weather forecasting, fish management, potato exports, auto production, sports broadcasting, and home video equipment.

The global challenge in science and technology affects all aspects of Canadian society, from the basic industrial structure to new employment opportunities, from the locus of new ideas, products and investment to the shape and growth of new factories and products. We can identify four broad trends:

1. Globalization -- McLuhan coined the phrase "The Global Village", but he did not recognize the implications in terms of the global marketplace. Increasingly the world is a single market -- for ideas and products, for skilled labour and capital. Science, in particular, is a free trade arena, where the spread of ideas, discoveries and processes is increasingly instantaneous.

2. Triad Competition -- After World War II, the United States dominated scientific production, economic output, and technological prowess. Since then, dramatic changes in Europe, Japan, and the NICs of Asia have transformed the industrial landscape. No single economic power dominates the global economy, although the U.S. is still the pre-eminent scientific power. Moreover, economic strength is not directly correlated with pure scientific research output measured, for instance, in Nobel prizes or academic output. Modern technology has transformed the science-technology paradigm, such that commercialization of science is a key to economic growth and wealth generation.

3. Production Technology -- Most twentieth century manufacturing has been based on traditional mass assembly production. The information and electronics revolution has changed this fundamentally: flexible manufacturing, shorter production cycles, infinite variety, small lead times, integration of product design and production. Managing the shorter production cycle is central to competitiveness and sustained job creation.

4. Organizational Flexibility -- Whether in public or private bureaucracies, the key to success is adaptiveness, agility, and flexibility. Instantaneous communications around markets and technologies require knowledgeable managers and workers to respond quickly and plan smartly. Competition may come from suppliers, customers or overseas markets as easily as from traditional competitors.

The Halifax conference, as the first ever meeting of Canada's Science Advisory Councils, presents a unique opportunity to establish a long term science agenda and the appropriate means for the Advisory Councils to work together, to learn from one another, to share information and studies, and to monitor and reflect on global changes. This paper sets out some of the key statistics on Canada's relative standing and position in science and technology. These provide insights into:

a) the quantity and quality of Canada's education establishment;
b) the level and balance of resource allocation between public and private sector;
c) Canada's fiscal environments for Science and Technology, relative to competitors;
d) Canada's capacity for basic research, as well as research priorities;
e) Canada's capacity for science-based innovation and technology diffusion;
f) Canada's science linkages around the world, including science monitoring;
g) Canadian technology skills and applications, in key technologies and in key sectors of the economy.

Comparative Ranking of Canadian R&D Performance	
Science and Technology Indicator	Eight Country Ranking[1]
Gross expenditure on R&D as a percent of GDP	Lowest
Industry funded R&D/GDP	Lowest
Government funded R&D/GDP	2nd Lowest
Government performed R&D/GDP	Middle
Higher Education R&D/GDP	2nd Lowest
Domestic patents granted per 100,000 inhabitants	2nd Lowest
International patents granted (by population)	Lowest
Advanced degrees awarded (by population)	Middle
Scientists and engineers in labour force (by population)	Lowest
Number of technology intensive industries with positive trade balance	Lowest

[1] Canada, Japan, U.S., Germany, France, Sweden, U.K., Netherlands

Source: Adapted from Canada Consulting Group and OECD Economic Indicators 1986

Comparative Levels of R&D Funding

	(1) Total R&D	(2) By Industry	(3) By University	(4) By Government	(2)/(1)
Canada	1.36	0.68	0.32	0.32	50.8
USA	2.89	2.07	0.39	0.34	71.9
Japan	2.81	1.88	0.57	0.28	66.8
Germany	2.66	1.92	0.40	0.33	72.2
Britain	2.33	1.47	0.32	0.46	63.1
Sweden	2.28	1.69	0.40	0.13	70.7
France	2.38	1.40	0.37	0.60	58.7
Netherlands	2.06	1.16	0.47	0.38	56.5

Source: Ontario Ministry of Industry, Trade and Technology

Public Expenditure on Education In Selected OECD Countries, 1984

	Total Public Expenditure on Education as a Share of GDP	Public Expenditure Per Student in U.S. dollars	
		secondary level	post secondary level
Sweden	7.79	3532	–
Netherlands	6.69	2477	9343
Canada	6.58	3523	6339
Australia	6.22	4504	7361
France	5.99	3057	3528
Austria	5.78	3672	4589
Italy	5.60	2153	3875
Japan	5.46	–	–
Switzerland	5.24	4185	8370
United Kingdom	5.23	2785	7606
Germany	4.45	3009	4814

Source: Education in OECD Countries: Comparative Statistics, OECD, April, 1988.
Note: Per capita GDP estimates are based on BLS purchasing power parities estimates for 1984 or 1985.

Sources of R&D Funds and Performing Sectors, Canada, 1986

Source of Funds	Performing Sector						
	Federal Laboratories	Provincial Laboratories	Provincial Research Organization	Business Enterprise	Higher Education	Private Non profit	Total
				$ millions			
Federal Government	1,417	—	8	409	524	26	2,384
Provincial Government	—	147	39	54	205	19	464
Provincial Research Organization	—	—	2	—	—	—	2
Business Enterprise	—	—	17	2,850	54	3	2,924
Higher Education	—	—	—	—	703	—	703
Private Non-profit	—	—	—	—	140	40	180
Foreign	—	—	2	515	11	—	528
Total	1,417	147	68	3,828	1,637	88	7,185

Source: *Estimates of Canadian Research and Development Expenditures by Region, 1979-86*, Statistics Canada, revised September, 1988.

Comparative University Funding Levels, U.S. - Canada
(Canadian Dollars, 1984-1986)

Institution Name	State & Local Appropriations Per FT Student	Tuition & Fees Per FT Student	Endowment Income Per FT Student	Govt't Grants & Contracts/ FT Student	Pvt Gifts & Contracts FT Student	Total Per FT Student
U Toronto	$7,746	$2,042	$808	$2,124	$1,127	$13,840
U.S. Institution Average	9,689	3,401	290	5,133	1,901	20,413
U California-Los Angeles	15,381	3,891	452	6,756	2,212	28,693
U Florida-Gainesville	11,523	1,453	0	3,448	2,112	18,537
U Illinois-Urbana	9,285	2,405	101	4,359	1,488	17,638
U Washington-Seattle	8,153	3,249	188	8,634	1,752	21,976
U Wisconsin-Madison	8,206	3,165	196	5,176	1,716	18,460
U Minnesota-Minneapolis	9,849	3,318	612	4,417	2,663	20,859
Ohio State U-Columbus	7,359	3,627	210	2,536	1,214	14,944
U Michigan-Ann Arbor	7,757	6,100	560	5,736	2,048	22,201

Source: Council of Ontario Universities

Incidence of Illiteracy in Canada by Socio-Economic Characteristics, 1987 (per cent of total)

	All Illiterates	Basic Illiterates	Functional Illiterates	Marginal Literates
Region				
Canada	24	8	16	9
B.C.	17	3	14	10
Alberta	21	8	13	11
Manitoba/Sask.	19	8	12	6
Ontario	24	7	16	8
Quebec	28	10	18	10
Maritimes	25	7	18	14
Newfoundland	44	21	23	4
males	27	9	17	9
females	22	7	15	9
Anglophone	29	11	19	9
Francophone	22	7	15	9
Age				
18-24	17	3	14	5
25-34	14	3	10	8
35-44	17	5	13	6
45-54	28	10	18	9
55-64	31	10	21	12
65 and over	45	20	25	15
Educational Attainment				
grades 0-4	72	52	20	4
grades 5-8	53	20	33	13
some high school	24	8	16	10
high school graduate	17	3	14	9
trade/vocational community college				
cegep	11	3	9	7
some university	13	2	10	6
university graduate	8	0	8	5
Occupation				
clerical	19	4	15	7
skilled labour	20	5	15	11
professional	32	15	16	7
business executive/owner/mgr	24	6	18	7
unskilled labour	28	12	16	10
sales	27	9	17	14

Source: Literacy in Canada: A Research Report, prepared for Southam News, The Creative Research Group Ltd., 1987.

A SURVEY OF COMPANIES ON R&D PERSONNEL AVAILABLE IN 1988

Reporting Shortages of Qualified R&D Personnel

	(% of companies reporting)
Technology-intensive companies	43.1
Small companies	37.8
Medium-sized companies	37.5
Large companies	25.6
Reporting Unfilled Positions Slowing R&D	69.4

Expecting Shortages to Persist in the Coming Five Years

Technology-intensive companies	60.8
All companies in sample	48.5

Source: Conference Board of Canada, *R&D Outlook, 1989*, Report 34-88, p. 9.

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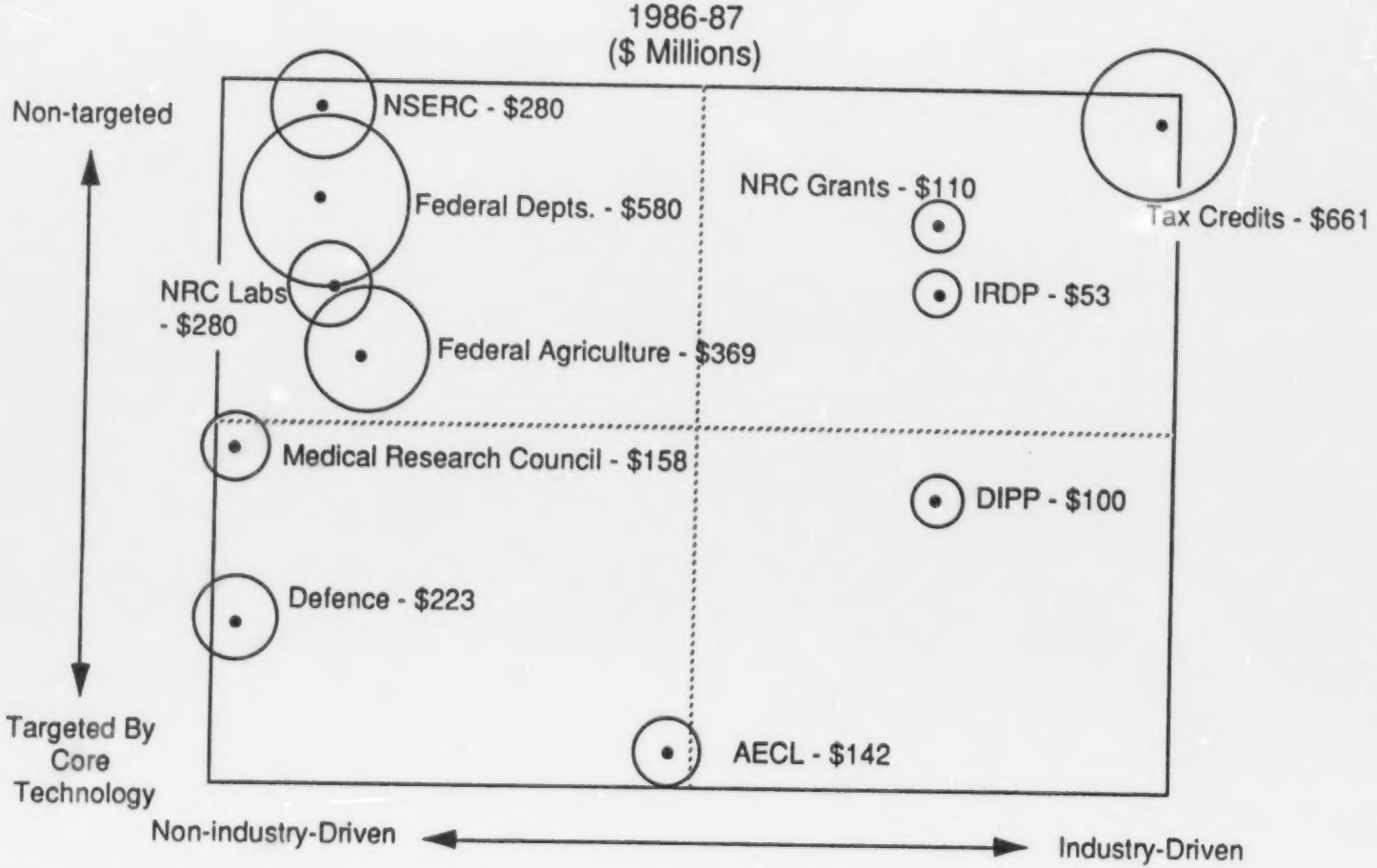


Source: Canada Consulting and Telesis analysis.

Note: In addition, the federal government has allocated $240 million towards Federal Centres of Excellence, for a five-year period beginning in 1988.

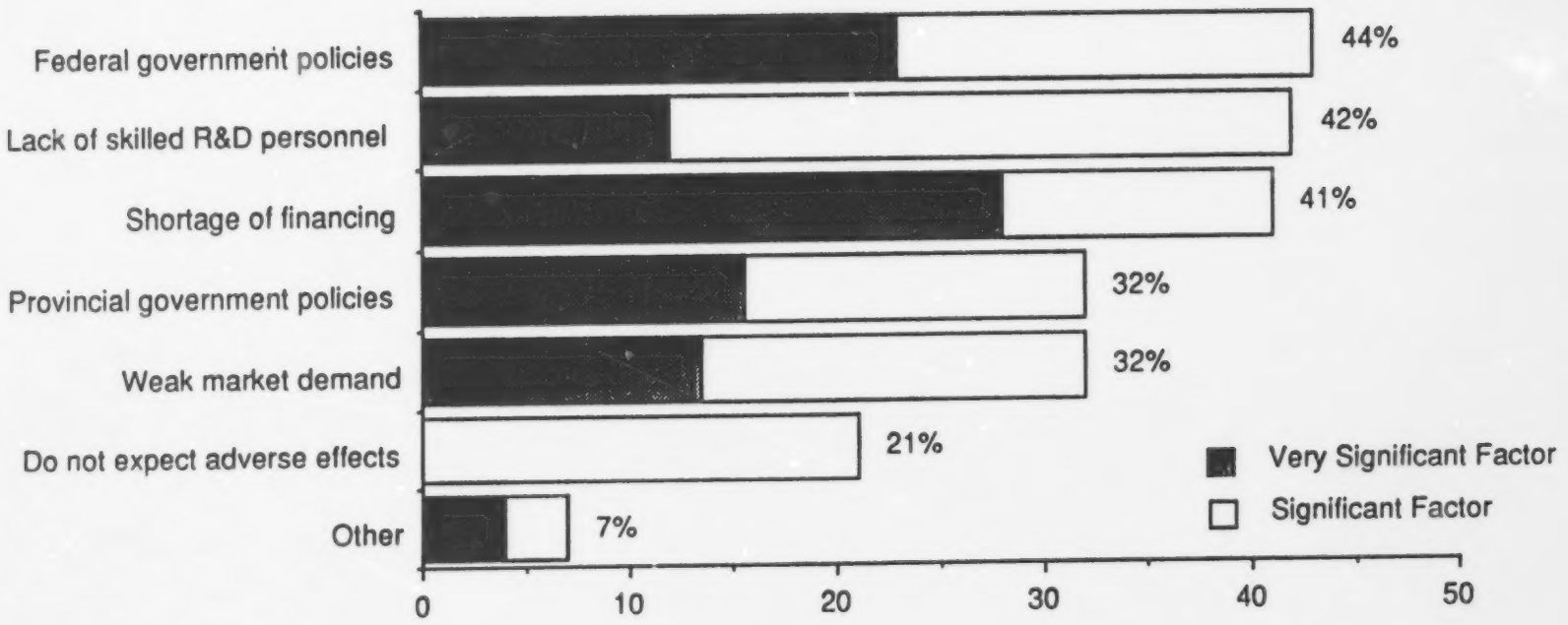
R&D Expenditures as a Percentage of Sales for Some R&D-Intensive Industries in Canada, 1979

	United States	Canada	Canadian controlled	Foreign controlled
Business Machines	11.8	1.5	8.0	1.3
Other Machinery	2.1	0.9	1.1	0.7
Aircraft & Parts	11.4	10.2	19.0	5.2
Communications Equip.	8.4	9.1	9.7	5.5
Other Electrical	5.1	1.4	1.0	1.1
Drugs & Medicines	6.1	4.7	7.5	3.5
Other Chemicals	2.7	1.0	2.6	0.7
Scientific Equipment	5.7	1.7	17.7	0.7

Source: Ontario, Ministry of Industry, Trade and Technology, *A commitment to research and Development: An Action Plan*, January 1988, p. 13

FACTORS CONSIDERED TO BE ADVERSELY AFFECTING R&D PROGRAMS

(% of Respondents)
Canada
1989



Note: Respondents could cite more than one factor. Consequently, answers may total more than 100 per cent.

Source: The Conference Board of Canada.

TAX INCENTIVES FOR RESEARCH & DEVELOPMENT IN MAJOR INDUSTRIALIZED NATIONS

1987

Country	Write-Off Period			General Investment Tax Credit Rate [1]				Relative Value of Tax Deductions and Credits for R&D in G -7 Countries
	Current Expend.	Mach. & Equip.	Bldgs. [3]	On Total Current Expend. [4]	On Total Mach. & Equip. [4]	On Total Structures [3]	Incremental Investment Credit	
Australia	1 Year [2]	3 Years [2]	3 Years	None	None	None	None	113
Canada Post-Reform	1 Year	1 Year	32 Years	22%	22%	None	None	100
France	1 Year	7 Years	11 Years	None	None	None	50%	81
United States Post-Reform	1 Year	5 Years	32 Years	None	None	None	20%	80
Japan	1 Year	5 Years	5 Years	6%	6%	6%	20%	80
United Kingdom	1 Year	1 Year	1 Year	None	None	None	None	76
Italy	1 Year	3 Years	33 Years	None	None	None	None	75
West Germany	1 Year	5 Years	22 Years	None	None	None	None	74

1. Expressed as an average rate.
2. 150% of the cost is permitted to be written off; will change to 100% in 1991.
3. Regular CCA rate of 4%.
4. Weighted average across Canada.

Source: Canada Consulting analysis based on interviews with Department of Finance.

R&D: Japan Gains on the U.S.

The U.S. shows greater strength in basic and undirected research, but Japan is gaining ground in these areas and clearly leads in development work having specific commercial applications. Here's an assessment of Japan's present R&D effort and its direction of change compared with the U.S. effort. It is based on a study by the National Science Foundation.

− behind	▼ losing ground
+ ahead	▲ gaining ground
● even	■ holding constant

AREA OF RESEARCH	BASIC RESEARCH		ADVANCED DEVELOPMENT		PRODUCT MANUFACTURING/ ENGINEERING	
	Japan's Position	Direction	Japan's Position	Direction	Japan's Position	Direction
Artificial intelligence	−	▼	−	■	−	■
Automated factory assembly	●	■	+	▲	+	▲
Biotechnology	−	■	●	▲	N.A.	N.A.
Compact-disk technology	−	■	+	▲	+	▲
Computer design	−	▼	●	▲	+	▲
Computer integrated manufacturing	−	▲	−	▲	+	▼
Computer software	−	▼	−	▼	+	▲
Fiber optics	+	▲	+	▲	+	▲
High-strength construction plastic	−	▲	−	▲	−	▲
Integrated circuits	+	▲	+	▲	+	▲
Mobile radio systems	+	▲	●	▲	●	▲
Telecommunication networks	−	▼	−	■	−	▲

Source: Gaining Ground, Ballinger Publishing, 1988

Key technologies: Who's ahead

Type of Technology	Present rank			Expected rank in 2000		
	U.S.	Europe	Japan	U.S.	Europe	Japan
New industrial materials						
High-temperature superconductor	1	3	2	1	3	2
Nonlinear opto-electronic materials	1	3	2	1	3	2
Ferromagnetic materials	2	3	1	2	3	1
Molecular functional materials	1	2	2	1	3	2
Durable, advanced composite materials	1	2	2	1	3	2
New alloys and intermetallic compounds	1	3	2	1	3	2
Fine ceramics	1	3	2	2	3	1
New function carbon-based materials	1	3	2	1	3	1
New function amorphous glass materials	1	3	2	1	3	2
High-purity fine polymers	1	3	2	1	3	2
Silicon-based materials	1	2	2	1	3	2
New microelectronic materials	1	3	2	1	3	2
Electronics						
Superconducting devices	1	3	2	1	3	1
Quantum effect devices	1	3	2	1	3	2
Power-electronics devices	1	3	2	1	3	2
New function optical devices	1	3	2	1	3	2
Large circuit devices	1	3	2	1	3	1
Biotechnology						
High-performance enzymes and biomaterials	1	2	3	1	3	2
Animal and plant cell engineering	1	2	2	1	3	2
New types of genetic engineering	1	2	3	1	2	2
Biomaterial databanks	1	2	3	1	2	3
Screening and isolation of genes from bacteria, animal and plant cells	1	2	3	1	2	3

Type of Technology	Present rank			Expected rank in 2000		
	U.S.	Europe	Japan	U.S.	Europe	Japan
Advanced know-how for utilizing bioreactions	1	2	3	1	2	2
Precision atomic handling know-how	1	2	2	1	2	2
New fabrication process technologies for metals and inorganic materials	1	2	3	1	2	2
Precision molecular alignment technology	1	2	3	1	2	2
Evaluation, analysis and measurement know-how	1	2	2	1	2	2
Design and simulation know-how	1	3	2	1	3	2
Photoreaction process know-how	1	2	2	1	2	2
Processing know-how using unusual conditions, like microgravity, high pressures, etc.	1	2	3	1	2	2
Biomaterials						
Biomimetic materials	1	3	2	1	3	1
Biocompatible materials	1	3	2	1	3	2
Biochemical know-how	1	3	2	1	3	2
Bioprocessing	1	2	2	1	2	2
Bioelectronics						
Techniques for protein alignment	1	2	3	1	2	3
Technology for utilizing biomembranes	1	2	3	1	2	3
Analysis system of bio-related materials	1	2	2	1	3	2
Computer software, system engineering						
Self-organized data-processing systems	1	3	2	1	3	2
Self-organized neural data-processing systems	1	2	3	1	2	2
Ultraparallel processing architecture	1	3	2	1	3	2
Integrated software for mechanical control	1	3	2	1	3	2
Software development know-how	1	3	2	1	3	2
Disaster prevention know-how	1	3	2	1	3	1
Environment control know-how	1	3	2	1	3	1
Human-related technology	1	2	2	1	3	2
Resources and energy know-how	1	2	3	1	3	2
Advanced robotics know-how	2	3	1	2	3	1

Notes: 1) denotes fields where newly industrializing economies are catching up. 2) The 47 technologies were selected based on the *"Sangyo Gijutsu no Doko to Kadai" (White Paper on Industrial Technology)* issued by the Ministry of International Trade and Industry in Sept. 1988.

Industry, Science and Technology Canada
Industrie, Sciences et Technologie Canada

THE SCIENCE AND TECHNOLOGY POLICY STRUCTURES IN SOME MAJOR INDUSTRIALIZED COUNTRIES

Industry, Science and Technology Canada

Ottawa

June 1989

Canada

INNOVACTION
The Canadian Strategy for Science and Technology
La stratégie canadienne en matière de sciences et de technologie

PURPOSE

The purpose of this paper is to compare the science and technology (S&T) policy structures of seven major industrialized countries. The countries considered in this analysis are the United States, Japan, the United Kingdom, Australia, France, the Federal Republic of Germany, and Canada.

ANALYSIS OF S&T PORTFOLIOS

UNITED STATES

The Office of Science and Technology Policy (OSTP) was tasked in 1976, under President Gerald Ford, to "serve as a source of scientific and technological analysis and judgement for the President with respect to major policies, plans, and programs of the Federal Government (12)."

The Director of OSTP is the President's Chief Scientific Adviser whose duties are[1]:

- to advise the President on scientific and technological considerations in the federal budget, assist the Office of Management and Budget with an annual review and analysis of funding proposed for R&D in the budgets of all federal agencies and aid the Office of Management and Budget throughout the budget development process;
- to provide, within the Executive Office of the President, advice on the scientific, engineering, and technological aspects of issues that require attention at the highest levels of government;
- to advise the President of scientific and technological considerations involved in areas of national concern, including, but not limited to, the economy, the environment, and the technological recovery and use of resources;
- to evaluate the scale, quality, and effectiveness of the federal effort in science and technology and to advise on appropriate actions; and
- to assist the President in providing general leadership and co-ordination for the R&D programs of the Federal Government.

The Director of the OSTP chairs the Federal Coordinating Council of Science, Engineering and Technology created in 1976 to provide a focal point for the activities in these areas within the U.S. Administration.

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[1]President George Bush, in his budget proposals for 1990, proposed to elevate the position of Director of the OSTP to Assistant to the President for Science and Technology to permit direct access to him, thus giving this position the same status as that of the National Security Adviser.

The OSTP shares the role of providing advice on S&T matters to the President and participating in the S&T budget allocation process with other agencies and organizations such as the Office of Management and Budget (OMB), the American Association for the Advancement of Science (AAAS), the National Academy of Science (NAS), and the National Science Foundation (NSF). The division of functions among these institutions is described below.

Office of Science and Technology Policy (OSTP)

The OSTP takes a strategic approach to resource allocation. It deals with about 25 major agencies and provides policy advice and priorities to the President and the Office of Management and Budget. The heads of approximately one half of these agencies are invited to meet annually with the President's Science Adviser and senior staff to explain what they intend to do in strategic terms over the following several years and how they will achieve their objectives. There is no formal agenda but a good appreciation is obtained of intentions and thrusts.

The OSTP is primarily interested in new research activities. Suggestions for cuts in programs are usually left to agencies.

There is no attempt to establish priorities across different science fields. The approach is rather to identify gaps and areas of opportunity in particular areas.

Office of Management and Budget (OMB)

The OMB oversees the expenditures for science within the mission budgets of the agencies. There is no science budget as such but the OMB does publish an addendum called the "Special K Report" to the main budget. This consolidates all science expenditures in one volume. Information is broken down by agency, and by science activities according to categories of basic, developmental, and applied research.

The OMB usually deals with the budget for agencies at the macro level with due regard for the President's and OSTP priorities. Occasionally the agency may evaluate projects when too many of them are submitted at the same time. The OMB raises such issues as:

(i) the gains to be obtained;

(ii) the size of the community that will benefit now and in the future;

(iii) the potential for cost overruns;

(iv) the technical risks;

(v) the state-of-the-art in the discipline, and the likelihood that research will provide a significant move forward;

(vi) the opportunity cost of proceeding with the project;

(vii) the reason why the project must proceed now;

(viii) the ability of the program structure to provide for adequate coordination, and the possibility of duplication of work in other agencies; and

(xi) the filling of a niche, and the extent of international collaboration to share costs.

In order to accommodate agencies in its review of their budgets,the OMB allows for: (i) the maintenance of reference levels, (ii) adjustments for inflation, (iii) new proposals originating in the agency, (iv) new programs consistent with the administration's priorities, and (v) new proposals agreed upon by the agency and OSTP - OMB.

American Association for the Advancement of Science (AAAS)

The AAAS involves itself in the federal S&T budget allocation process in three ways:

(i) shortly after the President presents his budget proposals for the coming fiscal year in January, the AAAS publishes an analysis of the R&D items. This report provides an overview of policy issues and a breakdown of budgets by major agencies and disciplinary areas;

(ii) a colloquium is convened in the spring to discuss the above report with about 500 attendees. The colloquium proceedings are published and, with the report, sent to congressional and senate committees. These reports are available before appropriations are made in the following September; and

(iii) a final report is released after Congress has appropriated funds. This report compares proposed and actual appropriations, major issues, trends in expenditures, and implications to individual agencies.

National Academy of Sciences (NAS)

Each year the NAS prepares comprehensive research briefings to the President's Chief Scientific Adviser through its Committee on Science, Engineering and Public Policy (COSEPUP). They constitute a rich set of assessments of recent advances and opportunities in critical fields of S&T.

Panelists are chosen from all fields of science for their expertise and ability to draw out the essence of their work for policy decision. The panelists are not usually paid for their contributions. At the end of their work, they present their findings to senior officials in OSTP, NSF, OMB, science-based agencies, and congressional committees' staff. Their reports are published and provide a basis for discussion of priorities across science fields.

National Science Foundation (NSF)

The NSF prepares its budget on a bottom-up basis, taking into account: (i) requests from universities, (ii) external advice from outside panels, (iii) academic reports provided by NAS and AAAS, and (iv) the experience of their program officers. It establishes priorities that build on core programs by identifying themes of current interest and the provision of funds for strategic areas.

The present NSF priorities are: (i) investment in science and engineering personnel, (ii) improved infrastructure and instruments, (iii) strengthened economic competitiveness, (iv) leverage from federal funds, and (v) support for emerging technologies (biotechnology, computer science, and global geosciences).

The NSF uses peer review to determine what specific projects should be supported. Only about 30% of projects are accepted for funding. It avoids targeting specific fields but does take care that there is balance across the range of projects that are supported.

Many universities receive funds from the states and private endowments but the federal government remains by far the most important source of funds.

The NSF does not have criteria for project evaluation.

The NSF funds research centres at universities for a period of not more than five years. Matching funds from industry are sought at the 20-50% level.

It should be noted that, in addition to the above organization, the National Academy of Engineering (NAE) and congressional committees on science and technology also contribute to the budget allocation process. The former provides input to the budget proposals prepared by the National Science Foundation, and the latter review the budget submitted by the OMB to Congress.

The National Academy of Engineering is closely affiliated with the Academy of Sciences. These two organizations, along with the Institute of Medicine, form the National Research Council, which has the responsibility of providing analytical reports to the U.S. government on key science and technology issues.

JAPAN

The agency responsible for coordinating the Japanese government's research effort is the Science and Technology Agency (STA). Established in 1956 within the Prime Minister's office, the Agency is headed by the Minister of State for Science and Technology. Its duties include the following (7):

- Planning, formulation, implementation and coordination of science and technology policies;
- Coordinating science and technology activities undertaken by various ministries and agencies and their budget allocations;
- Subsidization of research requiring the cooperation of many departments;
- Promotion of major research and development projects under an integrated government policy, including the following fields:
  - Atomic energy
  - Space development
  - Ocean development
  - Life sciences
  - Materials;
- Reinforcement of the foundations of research and development, and improvement of current research activities, systems and environment;
- Planning of measures for integrated utilization of resources;
- Conducting surveys and analyses of domestic and foreign aspects of science and technology; and
- Providing administrative support to science and technology advisory bodies including the Council for Science and Technology, Atomic Energy Commission, Space Activities Commission, and the Nuclear Safety Commission.

The STA plays an important role in the coordination of Japan's R&D budget:

i) R&D activities are proposed by the laboratories and public corporations under the aegis of particular ministries and agencies;

ii) items for coordinated research or block funding are negotiated jointly by STA and the ministry/agency concerned;

iii) ministries and agencies submit budget requests to the Ministry of Finance, including R&D items;

iv) R&D items are packaged for review by STA; and

v) authorization is provided by the Ministry of Finance based on STA review.

In addition to the above coordinating role, the STA prepares an annual White Paper on Science and Technology which serves as the guideline for priority-setting in the year ahead.

The STA's work is guided by the Council for Science and Technology, an eleven-member central Cabinet-level policy advisory body under the chairmanship of the Prime Minister. The Council consists of the Minister of Finance, the Minister of Education, Science, and Culture, the Minister of State for Economic Planning, the Minister of State for Science and Technology, the President of the Science Council of Japan and five members of outstanding knowledge and experience appointed by the Prime Minister with the consent of the Diet.

The Council of Science and Technology was established in February, 1959 as the supreme advisory body to the Prime Minister in formulating and promoting comprehensive policies in the science and technology area (8).

According to law, the Prime Minister is required to consult with the Council, whenever it is necessary to coordinate the policies of the various administrative agencies concerned, with regard to:

i) formulation of fundamental and comprehensive policies for science and technology in general (excluding those limited to cultural sciences only);

ii) establishment of long-term and comprehensive goals for research and development in science and technology;

iii) measures for the promotion of research and development of special priority, in order to achieve the goals; and

iv) items of special importance to be submitted to the Science Council of Japan or those related to the reports and recommendations made by the agency.

The Prime Minister is obliged by law to fully respect any reports submitted by the Council for Science and Technology as a result of such consultations.

The Council is supported in its administrative tasks by the Science and Technology Policy Bureau of the Science and Technology Agency and by the Science and International Affairs Bureau of the Ministry of Education, Science, and Culture. In addition, the National Institute of Science and Technology Policy was established in 1988 under the Science and Technology Policy Bureau of the Science and Technology Agency in order to further support the Council in formulating policy.

UNITED KINGDOM

Priorities in science and technology policy in the United Kingdom are decided by collective ministerial consideration under the leadership of the Prime Minister (2).

The Prime Minister is advised on such matters by her Chief Scientific Adviser, the Cabinet Office, and also, since September 1987, by the Advisory Council on Science and Technology (ACOST), which absorbed the former Advisory Council for Applied Research and Development (ACARD). The mandate for ACOST covers defence as well as civil research and both academic science and industrial research and development. Appointed by the Prime Minister, ACOST is composed of industrialists and scientists covering all areas of science and technology and selected for personal eminence in their fields. In addition, there are three ex-officio members, the chairmen of the Department of Trade and Industry's Technology Requirements Board (TRB), the Advisory Board for the Research Councils (ABRC) and the University Grants Committee (to be replaced by the Universities Funding Council in 1989). ACOST advises on national priorities in science and technology, on the application of the results of scientific research, on the co-ordination of government policy for science and technology, and on United Kingdom's participation in international scientific projects.

In addition, a new independent Centre for Exploitation of Science and Technology (CEST) has been set up following an earlier recommendation by ACARD. The Centre, based at Manchester Science Park, aims at identifying exploitable areas of science and is being supported by a consortium of companies and by the government.

Responsibility for basic civil science rests with the Secretary of State for Education and Science (DES), who is advised by the ABRC; that for technology rests mainly with the Secretary of State for Trade and Industry (DTI), who is advised by the TRB. Other departments with a substantial involvement in science and technology have a Departmental Advisory Body; these bodies work closely with ACOST. A committee of Departmental Chief Scientists, under the chairmanship of the Chief Scientific Adviser, is responsible for co-ordination among departments. A Science and Technology Assessment Office, responsible to the Chief Scientific Adviser, evaluates the impact of government-funded research on the efficiency and competitiveness of the economy.

The Department of Trade and Industry (DTI)

Although most industrial research and development is financed by industry, the Department of Trade and Industry (DTI) provides support for a wide range of research projects, technology transfer, awareness, training and advisory activities which would bring economic benefits, but would not otherwise be undertaken by industry.

A major review of the Department's support - including support for innovation, - has been carried out. The conclusions, which were published in a White Paper in January 1988, were that the Department should withdraw its innovation support from market-related activities. The recommendation was that the

Department should concentrate primarily on the circumstances where research was necessary before commercial applications could be developed or where the benefits of the research were likely to be widespread, and on technology transfer. In practice, this has meant moving away from supporting product and process development in single companies and giving greater emphasis in collaborative programs to longer-term research between companies and to encouraging collaboration between higher education institutions and companies. Also, greater emphasis is being given to encouraging and facilitating the many different aspects of technology transfer.

The Government announced in December 1986 the establishment of a new program called the LINK scheme which aims to encourage collaborative research between the public and private sectors in areas of science expected to have future industrial applications. The first ten programs under the scheme had been announced by September 1988 and were to come into operation during the following year.

The Department of Trade and Industry (DTI) has four research establishments: the National Physical Laboratory, the National Engineering Laboratory, the Laboratory of the Government Chemist, and the Warren Spring Laboratory. These provide support for industrial innovation through sponsored research and industrial 'club' projects among others. Plans were announced in June 1988 to privatize the National Engineering Laboratory, where roughly three-quarters of the work was for the benefit of industry, and to establish the other three as separate agencies within the public sector.

The DTI is advised with respect to this support for industrial research and development by a number of advisory committees, which consist of representatives of both industry and research organizations.

The DTI maintains close contact with the British Technology Group (BTG), an independent public corporation which promotes the transfer of technology from the laboratory to the marketplace. The BTG takes responsibility for licensing inventions, particularly those emanating from universities and other public sector research organizations; in return, it takes a proportion of the licensing income. It also provides development finance for industrial projects embodying new technology, for up to 50 percent of their cost. The loan is repayable through a levy on sales of resulting products or processes.

The Department of Education and Science (DES)

The Department of Education and Science discharges its responsibilities for basic and applied civil science mainly through the five research councils, to which it allocates funds from its science budget. These councils are: the Science and Engineering Research Council, the Medical Research Council, the Natural Environment Research Council, the Agricultural and Food Research Council, and the Economic and Social Research Council. Science budget grants are also made to the Royal Society and the Fellowship of Engineering for science policy studies commissioned by the Advisory Board for the Research Councils and for an allocation in support of CEST. The allocations provide support for research in the form of grants and contracts to universities, polytechnics, research units and other establishments of the research

councils, postgraduate support and subscriptions to international scientific organizations. The Department is also responsible for some aspects of international scientific relations and helps co-ordinate government policy regarding scientific and technical information. Together with the Scottish Education Department, it funds various schemes for training students and those working in industry in the latest technology areas. For example, under the Professional, Industrial and Commercial Updating Program (PICKUP), a network of nine New Technology Centres was established in 1987-88; in these, scientists from higher education institutions will train employees of private companies in recent developments in their fields. The Department is also encouraging, through a variety of initiatives, the teaching in schools of scientific and technical subjects, such as computing and craft, design and technology.

The Department is also the main source of funding for the universities, whose individual allocations are determined by the University Grants Committee. Although each university decides upon the division of its resources between teaching and research, the proportion committed to research is generally believed to be between 30 and 40 percent.

The Advisory Board for the Research Councils (ABRC)

The Advisory Board for the Research Councils (ABRC) advises the Secretary of State on civil science, particularly with regard to the research council system, on the support on postgraduate students, on the proper balance between national and international scientific activities, and on the allocation of the science budget among research councils and other bodies. It also promotes close liaison between the councils and industrial users of their research. Its members are drawn from the research councils, government departments, industry and the academic world.

The Research Councils

Each of the four research councils engaged in scientific research is an autonomous body established under Royal Charter with membership drawn from the universities, professions, industry and the government. They conduct research through their own establishments and by supporting selected research, study and training in universities and other higher education establishments. They also receive income for research commissioned by departments under the customer-contractor principle and from the private sector. Income from commissioned research is particularly important for the Agricultural and Food Research Council and the Natural Environment Research Council.

The rights and responsibility for the commercial exploitation of research carried out with the support of research council grants rest with the institution receiving the grant, subject to the existence of procedures agreed to with the sponsoring research council. Universities and research institutes may still make use of the expertise of the British Technology Group to patent and license their inventions, but are no longer obliged to do so.

Science and Engineering Research Council (SERC)

The Science and Engineering Research Council (SERC) is responsible for the support of research work, postgraduate training, and applied science (including engineering) outside the areas of agriculture, medicine and the environment. Within higher education establishments, it encourages collaboration with industry, partly by sponsoring co-ordinated research programs in areas of special concern to industry, such as information technology and biotechnology. Six such areas were designated and put under the control of directorates, of which two have been transferred to the private sector. SERC has initiated plans for four interdisciplinary research centres based at the universities of Cambridge, Glasgow, Liverpool and Oxford to carry out planned research programs in the fields of high-temperature superconductivity, engineering design, surface science and molecular sciences respectively, and involving researchers from other higher education institutions.

SERC maintains four research establishments: the Rutherford Appleton Laboratory (RAL) at Chilton (Oxfordshire), the Daresbury Laboratory at Warrington (Cheshire), the Royal Greenwich Observatory at Herstmonceux (East Sussex), which is to be moved to Cambridge in about 1990, and the Royal Observatory, in Edinburgh. These establishments are centres of specialized research, and are also used for the development and operation of central experimental facilities beyond the resources of an individual academic institution. They provide support for scientists whose research requires access to facilities run by international research organizations such as the powerful particle accelerators at the European Centre for Nuclear Research (CERN) in Geneva, and the high-flux neutron source at the Institute Laue-Langevin in Grenoble. SERC also provides all or part of United Kingdom's contribution to these and other international facilities and organizations such as the European Space Agency, to which funds are channelled through the British National Space Centre.

AUSTRALIA

Following a re-organization of the Australian government in July 1987, the Department of Science was abolished and its science and technology functions were streamlined and absorbed into the Department of Industry, Technology and Commerce (DITAC) (1). A Science Adviser was appointed to the Department in 1987 and reports directly to the Minister of Science, Customs and Small Business who in turn reports - as a junior Minister - to the Minister of Industry, Technology and Commerce.

Even though most departments in the Australian government undertake or fund scientific research and therefore have science policy interests, DITAC has the major responsibility for science and technology under the government's present administrative arrangements. The Commonwealth Scientific and Industrial Research Organization (CSIRO), the Australian Nuclear and Science Technology Organization (ANSTRO), the Australian Institute of Marine Science (AIMS), and the Commission for the Future (CFF), are organized within this portfolio.

The Australian Science and Technology Council (ASTEC) was established as a statutory authority in 1979 and is the government's principal source of independent advice on a wide range of policies and programs relating to science and technology. ASTEC is empowered to operate by conducting inquiries, gathering information, engaging consultants, appointing committees and producing reports, which may be initiated by the Prime Minister or itself and are tabled in Parliament. ASTEC reports to the Prime Minister. A large proportion of Australia's research is undertaken by government research organizations, the principal organizations are:

The Commonwealth Scientific and Industrial Research Organization (CSIRO)

In July 1987, a major reorganization of CSIRO was announced following a review by ASTEC. The aim was to place greater emphasis on the link between scientific research and its economic and social benefits to Australia and to promote closer cooperation between CSIRO and the private sector, especially industry. The main role of CSIRO will continue to be the performance of long-term strategic research which is of potential benefit to Australia and which is beyond the capabilities of individual Australian companies or agencies. Under the new structure, CSIRO has 32 divisions associated with the following bodies:

- Institute of Information and Communication Technologies
- Institute of Industrial Technologies
- Institute of Minerals, Energy and Construction
- Institute of Animal Production and Processing;
- Institute of Plant Production and Processing;
- Institute of Natural Resources and Environment

The Australian Nuclear Science and Technology Organization (ANSTO)

ANSTO was formed in April 1987 replacing the Australian Atomic Energy Commission (AAEC) and was aimed at providing a new direction for nuclear science and technology in Australia.

The Australian Institute of Marine Science (AIMS)

AIMS carries out research in marine science and collaborates with other institutions in carrying out such research. AIMS, as a major government funded research laboratory in marine science, emphasizes the inter-disciplinary nature of its research programs which is necessary because of the complex environment within which the organization operates.

The government has recently reviewed Australia's marine industries and marine science and technology capabilities. It is proposed that an Australian Marine Industries and Sciences Council (AMISC) be established for policy formulation, strategic planning and funding.

The Commission for the Future (CFF)

The CFF is not a research body. It is a national organization which carries out education and public awareness programs intended to stimulate discussion of the social and economic impacts of technological change and of the long-term options for Australia.

The Defence Science and Technology Organization (DSTO)

DSTO contributes to the development and implementation of Australian defence policies through the application of science and technology, including the provision of assistance to the Australian Defence Force, the Department of Defence, other defence agencies and, as necessary in the direct interests of Australian defence, Australian industry.

The Bureau of Mineral Resources, Geology and Geophysics (BMR)

The BMR is a geoscientific research organization within the Department of Primary Industries and Energy. The BMR's activities are undertaken through six major programs:

- Fossil Fuels and Minerals Research
- Groundwater Research and Assessment
- National Geophysical Observatories and Antarctic Surveys
- Petroleum and Minerals Resource Assessment
- National Geoscience Databases
- BMR Management and Information

Higher Education Institutions

Post-secondary (tertiary) education in Australia is funded largely by the Commonwealth Government and divided into three areas: universities, colleges or advanced education; and the technical and further education system.

In addition to providing general financial support for higher education, the Australian government funds research undertaken in universities and elsewhere through a number of schemes. In some cases, Commonwealth funds are

supplemented by monies from State Governments and statutory research levies imposed on specific industries, usually matched on a 1:1 basis and called Rural Industry Research Trust Funds (RIRFs).

- The Australian Research Council (ARC) was formed recently in response to ASTEC's review of R&D in the higher education sector. The ARC advises on national research policy and priorities and on the coordination of the national research effort.

- The National Health and Medical Research Council (NH&MRC) is an independent body which advises the Minister for Community Services and Health on the application of funds from the Medical Research Endowment Fund. NH&MRC grants form the major proportion of the total Commonwealth funds spent on medical research in Australia.

- National Energy Research Development and Demonstration Council (NERDDC) advises on the coordination and development of a national energy R&D program and recommends support for individual research, development and demonstration projects. Projects are funded through the Energy Research Trust Account (ERTA).

Where there are areas of research involving both State and Federal Governments, joint advisory committees have been established to coordinate scientific and technical activities. Among these are the Australian Agricultural Council and the Australian Fisheries Council.

The Australian Industry and Technology Council (AITC), formed in 1984, is a joint Commonwealth and State Ministerial Council. It is a vehicle through which the different industry and technology responsibilities and policy instruments of the Commonwealth and the State can be harmonized. Some of the policy issues considered by the AITC include matters such as innovation, research and development, and education and training.

Advice on scientific and technological issues comes also from various learned and professional bodies such as:

- The Australian Academy of Science
- The Australian Academy of Technological Science and Engineering
- The Academy of Social Sciences in Australia
- The Australian Academy of the Humanities

In addition views on science and technology are often expressed by the Federation of Australian Scientific and Technological Societies (FASTS), a lobbying body for Australian science and was formed in 1985 and by the Australian and New Zealand Association for the Advancement of Science (ANZAAS) which meets regularly.

FRANCE

The current emphasis on S&T as an engine of economic growth in France has its roots in one of President François Mitterand's public statements made during his first presidential electoral campaign: "Chercheurs français, retrouvez confiance...au temps du mépris, je substituerai le temps du respect et du dialogue (3)." (French researchers, be self-confident again... Instead of the current mistrust, I will offer you respect and dialogue.) Following his election, the President paid special attention to the development of S&T in France by sensitizing the public to the important role of S&T in the revitalization of the French economy. This effort was reflected in a series of regional workshops on S&T issues and concluded with a national conference on research and technology (le Colloque national: recherche et technologie) held in January, 1982. It was during this conference that the future direction of S&T development in France was mapped out.

Ministry of Research and Technology

The lead agency responsible for national R&D efforts in France is the Ministry for Research and Technology established in 1981 and headed by a Cabinet Minister reporting to the President.

The Ministry of Research and Technology is responsible for defining and implementing, in collaboration with other concerned ministries, government policies in the science and technology area (11).

In order to fulfil this interministerial mandate and to play fully its leadership, expertise, and evaluation role, the Ministry has at its disposal considerable scientific capability.

Specifically, the Ministry is responsible for the following tasks:

- Preparing, in collaboration with the Ministry of Economy, Finance and Budget, a budget proposal on civil R&D (budget civil de recherche et de developpement technologique, BCRD), to be submitted to Parliament annually;

- Preparing, in liaison with other concerned ministries, measures regarding the organization of public agencies and other research bodies and their staffs, as well as the implementation of a policy on the employment of scientists;

- Evaluating the research activities carried out by public agencies and other research bodies which are funded through the civil R&D budget; the Ministry is, in addition, consulted by state corporations on their research programs.

The Minister of Research and Technology, by delegation of the Prime Minister, chairs the Interdepartmental Committee on Eureka and sometimes chairs the Interministerial Scientific and Technological Research Committee and the Atomic Energy Committee.

The Minister shares, together with the Minister of Industry and Regional Planning, the responsibility for the National Agency for the Exploitation of Research and for the Science and Industry City; and, together with the Minister of Post, Telecommunications, and Space, the responsibility for the National Space Studies Centre.

In the area of international scientific cooperation, the Minister of Research and Technology monitors, with the Minister of Foreign Affairs and the Minister of Cooperation and Development, the related activities carried out by research institutions.

In addition, the Minister participates in the implementation of the national policy on information and scientific and technological culture.

FEDERAL REPUBLIC OF GERMANY (FRG)

The lead agency for R&D within the government of the Federal Republic of Germany is the Federal Ministry for Research and Technology (Bundesministerium fur Forschung und Technologie - BMFT) (10). The functions of this Ministry, which has been operating as a central agency since 1972, include the following:

- providing funds for R&D activities;
- coordinating all activities related to R&D among the various federal government departments;
- providing support to most high technology in the F.R.G.;
- sponsoring F.R.G. interest in areas such as: space, energy, information technology, biotechnology, laser technology, marine and solar research; and
- sponsoring national laboratories to conduct fundamental research, especially in particle and plasma physics.

The responsibilities of the Minister for Research and Technology are thus similar to those assigned to the Chief Scientific Advisers in other countries.

The BMFT provides support to the Federal-Laender Commission for Educational Planning and Promotion of Research (Bund - Lander - Kommission fur Bildungsplanung und Forschungsforderung - BLK), which was set up to coordinate research policy between the federal and laender (state) authorities.

In discharging its responsibilities, the BMFT is assisted, on policy issues, by numerous technical committees, panels of experts, and ad-hoc committees which provide advice to the Ministry on specific programs, projects, and issues.

In addition to the BMFT, there are two other bodies which have an important role in the conduct of R&D activities in the F.R.G.: the German Research Organization (Deutsche Forschungsgemeinschaft - DFG) and the Science Council (Wissenschaftsrat - WR).

The DFG is an autonomous organization which provides grants for research projects (mostly in universities), equipment for laboratories, scientific libraries, scholarships, and travel. The DFG is funded equally by the federal and state governments.

The WR is the principal advisory body for science policy at the political level. Established in 1957 by an agreement between the federal and state governments of the F.R.G., this organization consists of the following members:

- 6 members who are MPs appointed by the federal government;

- 11 members appointed by the 11 state governments. These are usually the Ministers of Culture or Education;
- 16 scientists appointed by the federal government; and
- 6 leading public figures from industry and business, appointed on the joint recommendation of the federal and state governments.

Of the above members, only the 6 federal and 11 state representatives have voting power.

The WR provides an essential federal/state advisory mechanism for S&T in the F.R.G., especially in the development of the university system and research enterprises.

CANADA

In 1964, following the recommendations of the Royal Commission on Government Organization (the Glassco Commission) (5), and those of Dr. C. T. MacKenzie, a former president of both the NRC and AECL, the federal government, under Prime Minister Pearson, decided to establish the Science Secretariat and the Science Council (4).

Science Council

The Science Council of Canada was established as a Crown Corporation in 1966. It was charged with, among other duties, advising the government on Canada's scientific and technological resource requirements and potential, and on the effective development and utilization of scientific and technological manpower in the country.

Science Secretariat

The purpose of this group, established within the Privy Council Office in 1964, was to provide information on scientific matters, on request from the Prime Minister, the Cabinet and its committees including the Treasury Board. The Secretariat was intended to provide the central agencies with a new dimension of scientific judgement, drawing from a national perspective. Its mandate was (6):

"To assemble, digest and analyze all information concerning the government's scientific and technological activities and their inter-relation with university, private industry, and provincial establishments."

The Secretariat, during its first year of operation consisted only of a Director (at the Deputy Minister's level). It was later expanded to include two Principal Science Advisers and eight Science Advisers. The first two Directors were Drs. Frank Forward and J. R. Weir.

The Science Secretariat was initially given the responsibility of providing administrative support to the Science Council after it was established. Due to the difficulty encountered by the Secretariat in providing support to both the government, which often dealt with confidential matters, and the Science Council, an advisory body operating on the principle of openness, the latter responsibility was discontinued in 1968.

The Secretariat then returned to its original role as the scientific arm of the Privy Council. Thereafter, the division of responsibilities between the Science Council and the Secretariat appeared to be clear: while the Council dealt with long-term issues and programs, the Secretariat handled the day-to-day problems of decision-making and implementation.

Following its separation from the Science Council, the Science Secretariat devoted much of its efforts to the definition of its relationship to the Privy Council and to the Cabinet. These efforts culminated in the appointment, in 1969, of Dr. R. J. Uffen as the Chief Science Adviser to the Cabinet and Director of the Science Secretariat (4). One of the key duties of the Chief

Science Adviser was to "re-energize" the Privy Council Committee on Science and Technology under the chairmanship of the Honourable C. M. (Bud) Drury, then President of the Treasury Board.

In 1971, the Secretariat was dissolved following the establishment of the Ministry of State for Science and Technology (MOSST), headed by its first Minister, the Honourable Alastair Gillespie (6).

In 1983, Prime Minister Pierre E. Trudeau re-activated the position of Chief Science Adviser and assigned it to the Secretariat of the Ministry of State for Science and Technology. In addition to normal responsibilities within the Ministry, the Chief Science Adviser was to advise the government on (9):

- the integration of a long-range scientific perspective into the policy development process and into specific proposals;
- the identification of areas which are science-and-technology intensive and which will have a significant impact on Canada; and
- the quality and effectiveness of science and technology policies.

In February 1986, the new Conservative Government of Prime Minister Brian Mulroney established the National Advisory Board on Science and Technology (NABST) with the following mandate: "to assess and to help develop national science and technology goals and policies and their application to Canada's economy, in so far as they relate to the development and exploitation of industrial technology".

Specifically, the Board advises the Prime Minister and the Government in the following areas:

- current and anticipated domestic and international developments and trends in science, technology and innovation affecting industry;
- review and comment on intramural programs in science and technology in the federal government;
- linkage between science and technology activities in the academic community and both the private and public sectors and international competitiveness;
- science and technology priorities for Canadian industry;
- ways of building a national consensus on such priorities; and
- ways of implementing these priorities.

The Board consists of representatives of the private sector, the academic community and labour groups as designated by the Prime Minister. NABST included: the Prime Minister as Chairman; the Minister of State for Science and Technology and the Minister of State (Science) as Deputy-Chairmen; the Deputy Minister of Industry Science and Technology as Secretary; and the

Minister of Finance, the Clerk of the Privy Council, the Chairman of the Science Council of Canada, the President of the National Research Council of Canada, and the President of the Natural Sciences and Engineering Research Council of Canada, as ex-officio members.

The board is supported by a Secretariat headed by the Deputy Minister of Industry, Science and Technology and staffed by personnel drawn from his department and elsewhere.

In August 1987, Prime Minister Mulroney announced the establishment of a new Department of Industry, Science and Technology. This department was designed to link science and technology with Canada's competitive industrial capacity. It was conceived as a flagship economic policy department, emphasizing the development and application of strategic technologies to promote a more internationally competitive industrial economy.

In May 1988, the government reintroduced a bill in the House of Commons to establish the department by combining the Department of Regional Industrial Expansion and the Ministry of State for Science and Technology. The mandate of the new department is defined as follows:

> "To develop national policies and programs designed to strengthen the economy, increase the international competitiveness of Canadian industry and encourage the fullest and most efficient use of science and technology in Canada."

At the time of this writing, the aforementioned bill had been introduced but had not been passed. However, the new department was fully operational.

In addition to NABST, which provides advice at the federal level, science and technology advisory councils being established at the provincial level to advise premiers and ministers on science and technology. These councils have undertaken major studies such as that reported in Ontario in "Competing in the New Global Economy" and have contributed to the development of provincial science and technology issues, the most recent of which is the British Columbia policy, "Strategies for Innovation". In addition to federal-provincial ministerial consultation which resulted in the National Science and Technology Policy (NSTP), mechanisms for consultation and cooperation between federal and provincial advisory bodies in the development of national science and technology priorities are being explored at present.

CONCLUSION

All countries surveyed have a lead agency or body tasked with the provision of advice on scientific and technological issues to senior political leaders. The manner in which these bodies are organized varies somewhat between countries. Nearly all of these bodies report at the prime ministerial level and consist of a membership representing various sectors of the country's science and technology community. Thus one finds that Japan's Council of Science and Technology, the Australian Science and Technology Council, the Advisory Council on Science and Technology in the U.K., the Science Council in West Germany, and Canada's National Advisory Board for Science and Technology all play this key role of providing advice to elected officials on science and technology matters.

The structures that have developed for advisory bodies in each country are undoubtedly tied to various factors such as the historical development of the governmental organization, the roles that the academic and industrial communities choose to play, cultural values, and the style of science and technology planning adopted (i.e. centralized or decentralized). While the purpose of this report is not to explain the manner of development of each of the advisory bodies, some characteristics are worth noting.

For example, in Japan, the Council of Science and Technology is the supreme advisory body to the Prime Minister on science and technology issues and the Prime Minister is required by law to consult with the Council and respect its advice. While this arrangement reduces the government's flexibility in dealing with advice, it contributes to the influence of the Council.

In Germany, the Science Council is the principal advisory body at the political level and is unique among the countries surveyed for the emphasis that is placed on federal and state coordination of science and technology activities.

In the United States, there is less central coordination and control in the development of policy than in other countries. While the U.S. President's Chief Science Adviser and the related Office of Science and Technology policy provide advice directly to the President, the relative importance of this position in the administration has fluctuated from President to President, and this advisory role is shared with other agencies and organizations. Special advisory bodies are also set up from time to time to assist the President in addressing a particular issue, such as the current Task Force on Competitiveness chaired by the Vice-President.

Since the French model is still evolving, it is too early to comment on its impact on the planning and undertaking of science and technology activities. It appears, nevertheless, that France's advisory mechanism is not as broadly based as those of the other countries in this study.

In Canada, the National Advisory Board on Science and Technology has provided a broad base of advice to the Prime Minister which has influenced the government's policy direction on a number of issues. The emergence of provincial advisory bodies on science and technology and the development of mechanisms for consultation between federal and provincial bodies should pave

the way to close and effective cooperation on the identification of national science and technology priorities.

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Science and Technology: Canadian Issues and Strategies

A Background Paper Prepared for

The National Forum of Science and Technology Advisory Councils

June 18-20, 1989
Halifax, Nova Scotia

Introduction

In preparation for the Halifax meeting, each of the participating advisory councils was asked to prepare a document which outlined the principal activities of the council, its priorities and current agenda. In addition, the councils were invited to suggest topics for discussion at the Halifax meeting. This paper is a synthesis of the separate submissions from the Councils. The first part of the paper is organized around the recommendations developed at the January 1988 Toronto conference and the five regional conferences. Excerpts from the final report of those conferences lead off each section and are followed by specific suggestions which were made by the Councils.

In addition to these issue-specific suggestions, the councils also provided some comments on their expectations of the Forum with respect of information regarding the formal and informal operations of other councils. This is provided in the accompanying document which contains the results of a survey of the Canadian science and technology advisory councils. The councils also provided some suggestions regarding mechanisms for future cooperation. These are listed in the second section of this paper.

LEADERSHIP

Mission Statement

To develop and support a generation of leaders in business and industry that understands the role of technology and innovation in enhancing competitiveness is able, with support from investors and government, to take risks in the interest of the long-term benefit of the corporation; and is capable of managing the integration of technology with capital, labour and resources into the strategic planning and management of the corporation.

Recommendations

1. Canadian companies should re-evaluate their long-term business plans in the light of ongoing changes in global markets and the growing role of technology and innovation in competitiveness.

2. Senior executives should aggressively seek out opportunities to use technology and innovation to create competitive advantage.

3. Industry should include technology and R&D managers in the strategic corporate planning process.

4. Companies must recognize the essential role of technology and innovation in the quest for excellence.

5. Large firms should set up specific offices and networks to search out innovative small Canadian firms who could act as suppliers and sub-contractors.

6. Government and industry should co-operate to strengthen the market and technology intelligence services available to firms.

7. Governments should introduce a wage-subsidy support program to encourage small and medium enterprises to hire scientists and engineers.

Councils touched on the above issues as they related to leadership, indicating and confirming the powerful coordinating role which government can play in mobilizing data and cooperation on science and technology issues.

Some Councils made specific recommendations. They include the following:

1. Undertaking a specific sector by sector assessment of science and technology priorities.

2. An assessment of priority sectors and technologies, relative to other provinces and countries and the methods to develop a strategy for each.

3. Analysis of the role and use of procurement strategies in public and other agencies for technological development and diffusion.

4. Regular science audits and methodologies for science resource allocation.

5. Cooperative meetings and joint sponsorship between public and private groups to mobilize human resources for technology initiatives.

6. Participation by smaller scale Canadian companies and entrepreneurs in international mutual-benefit projects, to increase domestic scientific and technological development and to access and adopt more foreign technology.

7. Addressing the appropriate roles of government, industry and the academic/research communities in research and development.

8. Methods and models of consensus building among governments - interprovincial, federal-provincial, and nation to nation - as well as among key institutional players in society - government, business, labour, and education.

9. Building better international linkages and cooperative ventures to promote the sharing and transfer of technology.

10. Vastly improved methods to gather and diffuse data and intelligence on national technology and easy access.

INVESTMENT AND FINANCE

Mission Statement

To develop a financial environment for business that encourages investors to support high-risk advanced technology ventures; that assists new companies to grow and stabilize; and that recognizes and responds to the different financial requirements of all phases of the innovation process that generate wealth from the results of R&D.

Recommendations

1. Governments in Canada should aim to provide a more attractive investment environment for technology and innovation that in competing industrialized countries within the next five years.

2. The federal government change the balance of favour in the tax laws to enhance equity investment over debt investment.

3. The reward/risk ratio investment favouring new and/or improved technology should be enhanced.

4. Inventing a "pooling" concept within equity markets, possibly involving the insurance industry, to spread risky investments over a broader base.

5. Stock exchanges in Canada should establish a separate list and index of high technology firms. This could be particularly important in regional markets, such as the Prairies, not notably associated at present with high technology ventures. The Quebec Stock Savings Plan is an excellent operating model for working through stock markets to support high technology R&D.

6. Provincial governments should establish tax policies and programs to encourage R&D in which measure of risk to investors is preserved.

7. The durrent definitions of R&D for tax purposes and technology transfer are too narrow and should be reviewed.

8. Government policy on intellectual property should be changed to assist the private sector: for example government research centres and labs should be able to engage in joint ventures with industry without all rights of ownership reverting to the crown; where intellectual property normally resides with government, if the private sector has

contributed to technology development, it might retain the intellectual property by paying a royalty.

9. Governments should use their purchasing power to help build technological capability in Canada by acting as a stable, patient client for start-up firms and by contracting out research projects to build broad new capabilities in Canadian companies.

10. Governments could assist in the innovation process by providing better access to information, such as by a Science and Technology Information Centre where industry could access information.

11. The federal government should, in conjunction with private sector organizations, consider establishing sectoral R&D targets over the next ten years within Canada.

The problem of funding for research and development has a number of facts, including the cost of capital, the role of the financial services sector, the federal and provincial tax regimes, the availability of long term "patient" money for technology, and the availability of equity capital. Specific suggestions advanced by the Councils:

1. Detailed and ongoing studies of Canadian tax incentives and tax measures vis-à-vis major Western countries.

2. Ongoing analyses of the effectiveness of industrial grants and tax incentives in promoting Research and Development.

3. Examination of methods to tap pools of private capital made up of small amounts and capable of improving risk reduction for new startups.

4. Governments offer many first class programs and program ideas, but most suffer from burdensome regulations, lack of urgency and no awareness of cash flow management across the technology cycle. Each Council should review the delivery of such programs.

5. The SRTC was an excellent idea made mortally vulnerable by systemic abuse outside the scientific community. Governments should examine a replacement, especially for technology startups.

6. Canada needs "big science" around big projects, Japanese-style consortia and pre-competitive business-university projects. More consideration is also needed for small scale projects involving multiple project feasibility work, community projects and technology application projects and novel methods to finance them.

7. Advisory Councils should examine, either by themselves or with the assistance of outside bodies, the cost and availability of capital for science at each stage of the technology cycle.

8. Councils should examine the incentives open to researchers in universities, government laboratories and provincial labs to develop commercial applications of intellectual property.

THE WORKPLACE

Mission statement

To develop relationships among players in the workplace that recognize the need for open, co-operative management and participatory planning to make effective use of both human and technological resources and to ensure that the workforce is aware of and prepared for the changes that accompany innovation.

Recommendations

1. Recognizing that labour must be a full participant in the process of technological change, Canadian industry will need to develop new and innovative approaches to managing technological change that stress employee skills updating and retraining strategies. Industry should regard the spending of a specific percentage of profits on training as an investment in competitiveness.

2. Industry should be involved in the planning, financing and operation of education and training programs, including co-op programs.

3. Companies should develop plans for managing technological change which recognize and deal with the uncertainty such changes create in the workplace.

4. Industry Science and Technology Canada should develop a major focus on the issue of human resource management in respect of technological change and competitiveness of Canadian industry.

5. Industry should develop techniques and for managing technological change to motivate the workforce to innovate.

6. A centre of excellence should be developed to study the social impacts of technological change, and how it can best be managed in the national interest.

Other workplace suggestions advanced by the Councils included the following proposals:

1. Develop better awareness programs and career counselling efforts to assist women in science careers and senior management positions.

2. Design management materials and programs for more effective technology diffusion in the workplace.

3. Encourage more scientific personnel in management positions.

4. Advise on ideal and workable methods for adjustment to technological change and techniques for business and labour cooperation.

5. Research and development strategies need to be thought out in terms of workplace implementation and technology diffusion. More information is needed on the particular roles of management, labour and workers in technology development strategies.

EDUCATION AND TRAINING

Mission statement

To develop and support an educational system that: challenges students at all levels to strive for excellence; clearly conveys the relevance of science and technology courses to the world outside the classroom; whose organization, attitudes and content recognize that education and training are lifelong activities, that includes technology content in all courses and that encourages more students to pursue careers that involve science and technology.

Recommendations

1. That all sectors recognize the life-long nature of the learning process. Work experience should be viewed as an integral component of education, and retraining as an integral part of the workplace activities. This should include greater recognition of students' work-related experience.

2. Industry should consider arranging secondments for teachers to provide them with relevant private sector work experience.

3. Governments should establish industrial advisory boards to examine existing school curricula, funding, teacher training etc., with the objective of encouraging an interest in science, technology and innovation at all educational levels.

4. Canada should consider national standardized testing. Although support for such testing was not unanimous, there was general consensus that such tests could be of value, if used in conjunction with other measures of achievement.

5. Business should help students see the relevance of science and technology, through such programs as 'adopt-a-school', co-operative education, internships and advisory committees.

6. Business should establish a mentor program through which students have an opportunity to work on projects alongside someone in industry. This could help to motivate students and to stimulate an interest in the sciences, where traditional teaching methods have failed.

7. Special training subsidies should be made available for small- and medium-sized enterprises.

8. Universities should encourage multidisciplinary studies among students, collaboration among faculty, and provide scholarships for existing primary- and secondary-level teachers to undertake science courses and degrees.

9. Industry - university liaison should be strengthened through sabbatials, joint R&D projects, etc.

Specific points advanced by the Councils in the field of education and training included the following:

1. Up-to-date examination of the science curriculum, including more advanced methods to retrain teachers and involvement of industry in designing relevant curriculum structure.

2. Better understanding of the life cycle chain of education and school, work career and job retraining in a multi-skilled and adaptable workforce.

3. A thorough review of teaching of mathematics in the school curriculum, drawing on the Canadian and U.S. experience.

4. Examination of better methods of job training and retraining of workers in basic industries such as fisheries and agriculture, as well as use of more advanced technologies in those primary sectors.

5. Consideration of a national system of student exams.

6. More flexibility for university funding, including differential student fees to promote excellence.

7. More effective development of research consortia, involving universities and the private sector.

8. Improved data banks on Canadian industrial training, mechanisms for teaching, and use of on-the-job techniques, possibly in conjunction with provincial community colleges.

9. Illiteracy is one of Canada's industrial blights. The Councils should take a leadership role in devising a national strategy for literacy, in concert with a national program to improve science and mathematics literacy, perhaps modelled on initiatives in Sweden, France and Japan.

10. Councils should investigate novel methods to promote computer literacy, possibly by contracting to private companies and better use of computer software in such areas as spelling, grammar and writing.

PUBLIC AWARENESS

Mission statement

To develop in Canada a society that is aware of the essential role of science and technology in society and in industry; that is able to deal effectively with the social and economic issues raised by these changes; that values and celebrates the achievements of our scientists and of innovative companies in concert with those of national heroes in other areas such as the arts and sports.

Recommendations

1. A working group be established, with wide representation from all sectors and provinces, to implement the ideas from the national and regional conferences.

2. Industry, the media and the government should cooperate to develop and publicize stories concerning:
   - successful examples of innovation in industry;
   - interesting applications and advances in science and technology; and
   - the vast array of ways in which technology affects individuals in every aspect of daily life.

3. Mega projects, such as the Frigate Program and the Space Program should have a public awareness component built into them.

4. Primary and secondary schools should incorporate courses that focus on developing entrepreneurship skills and an appreciation of science. Awards programs should also be introduced at the primary school level for achievements in science activities, and such programs should be carried right through to the post-secondary as a continuing incentive to students.

5. Industry should become involved in developing awareness of science in the 'real world' by participating in programs such as "Adopt-a-School". Successful projects like Shad Valley must be marketed more aggressively.

6. Companies should be encouraged to have a greater representation by scientists and engineers at management levels, or on their boards of directors.

7. The federal government should continue a public awareness campaign for science and technology in Canada.

Specific points relating to public awareness from the Councils:

1. Create Science and Technology information centres - links connected to and energising networks with easy access and knowledgeable assistance and staff.

2. Undertake to diffuse technology ideas to groups who operate on a small scale - say $100,000 or less - and in small communities.

3. Develop on a wider scale the program developed by the National Research Council, "Promotec".

4. Promote an awareness of a "balance sheet" of skills and technologies available not only province by province but region by region and community by community.

5. Regular review and assessment of target groups and media outlets for public awareness campaigns.

6. Develop science awareness programs around young people and science teachers, including prizes and awards.

7. Promotion of "Excellence in Innovation" awards for industry.

8. Regular science fairs, regionally and nationally, with profile speakers and financial backing.

9. A national program of "Young Scientists" awards to advance the cause of a Canadian science culture.

10. Publication of an annual report, detailing the status of science and technology initiatives province by province, as well as nationally.

Process Recommendations

As noted, the Halifax Forum is the first ever meeting of science and technology advisory councils. Some groups made specific recommendations concerning future cooperation, followup and coordination. These recommendations include:

1. A periodic meeting of council chairpersons to share advice and coordinate priority-setting.

2. Sponsorship on a periodic basis of a public forum or conference on science and technology, either regionally or nationally, involving one or more science advisory councils.

3. Followup conferences sponsored by the science and technology councils on specific topics such as technology collaboration or education and training.

4. Establishment of an annual or biannual Science and Technology conference, modelled on the Halifax Forum, to be hosted by a different council on a rotating basis.

5. Establishment of a permanent steering committee of representatives from the Councils.

6. An undertaking by the Councils to undertake specific studies or papers in areas of a "shared agenda" for presentation and use by the Councils, either separately or in cooperation.

7. Operate an exchange of Council experts, one council to another, for continuous learning and transfer of ideas.

8. Provide a more systematic bridge between the separate science and technology councils, operating within their own jurisdiction, and The Council of Science and Technology Ministers, representing the federal and provincial Science and Technology Ministers.